

## THE GENUS *DIGASTER* (MEGASCOLECIDAE: OLIGOCHAETA) IN QUEENSLAND

B. G. M. JAMIESON  
Department of Zoology, University of Queensland

### ABSTRACT

*Digaster* is here emended to exclude *Perissogaster excavata* and *P. nemoralis* but to retain *P. queenslandica*. The redefined genus is limited, as previously, to the montane coastal province of the Eastern Subregion of Australia. It consists of 17 species: 13 in southern Queensland, 2 in New South Wales and 2 species shared between the two states. Evidence given suggests that the genus has originated locally from holonephric species with a pair of combined male and prostatic pores on XVIII, or from meronephric monogastric descendants of these, and that origin, or at least major speciation, of the genus has been relatively recent. It is deduced that the digastric or trigastric condition of the genus is derived from the monogastric condition and that this multiplication of gizzards has occurred in Australia independently of other regions. A new generic definition and a key to all species are given together with descriptions of 5 new species, 2 new subspecies and of new material of 5 previously known species.

The genus *Digaster* was erected by Perrier (1872) for a single species, *D. lumbricoides*, from the vicinity of Port Macquarie in northern New South Wales. This remained the only known Australian oligochaete with two gizzards (the digastric or digiceriate condition) until Fletcher (1887) erected the genus *Didymogaster* for *Didymogaster sylvatica* from further south in New South Wales. The latter genus remained monotypic until Jamieson and Bradbury (1972) added the geographic replacement species *Didymogaster prothecata* and validated generic distinction from *Digaster*. The first additions to *Digaster* were *D. armifera* Fletcher, 1887 and *D. perrieri* Fletcher, 1889, also from New South Wales. Subsequently, Spencer (1900) added three species and Michaelsen (1916) and Boardman (1932) each added one species, all from Queensland. Three further Queensland species were added by Jamieson (1970, 1972). The present paper is devoted to description of 5 new species and 2 new subspecies of *Digaster* recorded in intensive collecting for oligochaetes in Queensland, from its southern border, at approximately 29°S., northwards along its eastern seaboard to Cooktown, at approximately 15°30'S., on Cape York Peninsula. A single, brief collecting foray on the Peninsula from its east coast at 15°30'S. to Normanton, near its west coast, at approximately 18°S. was unproductive, presumably because conditions were dry. The oligochaete fauna of the northern half of the

Peninsula and of its Carpentaria catchment thus remains unknown. The map of localities sampled will be limited to southern Queensland as the most northerly record for *Digaster* is 25°S.

The new additions bring the generic complement to sixteen digastric species and evidence will be given for the inclusion of a seventeenth species, the trigastric *Perissogaster queenslandica* Fletcher, 1889.

*Perissogaster* was first placed in the synonymy of *Digaster* by Beddard (1895) who included its three species and also *Didymogaster*. Michaelsen (1900, 1907) separated the three genera but Sweet (1900) and Jamieson (1963) again included the three species of *Perissogaster*, but excluded *Didymogaster*. Jamieson (1970) presented evidence in support of exclusion of the type-species of *Perissogaster*, *P. excavata* Fletcher, 1888 and of *P. nemoralis* Fletcher, 1889 and retention in *Digaster* of *P. queenslandica* but these changes were deferred pending examination of *Digaster lumbricoides*. The latter species was redescribed in Jamieson (1971b), in which a *lumbricoides* species-group was defined, and it will be appropriate in the present work to redefine the genus.

### Genus *Digaster* Perrier, 1872

*Digaster* Perrier, 1872, pp. 94-6; Michaelsen, 1900, p. 196; 1907, p. 162; Stephenson, 1930, p. 839.

*Digaster* (part.); Beddard, 1895, p. 484; Jamieson, 1963, pp. 85-6; Jamieson, 1971a, pp. 74-5; Jamieson, 1971b, pp. 1307-8.

DIAGNOSIS: Setae lumbricine. Gizzards 2, in V and VI or VI and VII, or 3, in V, VI and VII; extramural calciferous glands absent though poorly differentiated oesophageal pouches may be present. Intestine commencing in or behind XVII; typhlosole absent. Meronephric; the medianmost nephridium in caudal segments exonephric with preseptal funnel. Combined pores of a pair of racemose or tubuloracemose prostates and the vasa deferentia in XVIII or rarely in XVII. Testisacs absent. Spermathecal pores intersegmental or at the anterior margins of their segments.

DETAILED DEFINITION: Small to large terrestrial worms (28 mm to more than a metre long). Prostomium zyglobous to tanylobous. Circular in cross section throughout, with terminal anus. First dorsal pore in 3/4-11/12 (rarely far posterior?). Setae 8 per segment, in straight or irregular longitudinal rows; fairly closely paired; *cd* significantly wider than *ab* (minimally 1.2 *ab*); *dd:u* 0.2-0.8 in the forebody. Nephropores scattered, only sporadically visible. Clitellum annular, occupying 4-8 segments, the first segment occupied usually being XIII or XIV. Combined male and prostatic pores a pair on XVIII varying from median to *a* to *b* lines. Accessory genital markings present or absent. Female pores paired or, rarely, single; anteromedian to setae *a* of XIV. Spermathecal pores 2 or, rarely, 3 pairs, intersegmental or at the anterior borders of their segments, the last in or immediately behind 8/9, varying from median to *a* to *b* lines.

Dorsal blood vessel single, continuous onto the pharynx; last hearts in XII or XIII; supra-oesophageal vessel present but often poorly differentiated; the last hearts in and posterior to X latero-oesophageal; dorsoventral commissurals present anteriorly to the hearts. Subneural vessel absent. Gizzards 2, in V and VI or VI and VII or (*queenslandica* and rare individual variation) 3, in V, VI and VII; contiguous or separated by unmodified oesophagus. Oesophagus vascularized and internally folded and often dilated, in a few to most segments occupied, but extramural calciferous glands absent; intestine commencing in XVII to XIX; typhlosole, muscular thickening and caeca absent.

Wholly meronephric; micromeronephridia in anteriormost segments aggregated in bands or usually forming bucco-pharyngeal or exonephric tufts; succeeding nephridia exonephric astomate micromeronephridia; in the hindbody the medianmost nephridium on each side possessing a pre-

septal funnel which usually (and typically) is enlarged as an exonephric megameronephridium. Holandric (testes and funnels a pair in each of X and XI) or metandric (these in XI only); testis sacs absent; seminal vesicles in IX and XII, XI and XII or XII only. Prostates 1 pair, racemose or (*queenslandica*) tending to tubuloracemose; unipartite or bipartite; the vasa deferentia (always?) joining the junction of gland and duct. Penial setae present or, more commonly, absent. Ovaries 1 pair, in XIII; ovisacs absent. Spermathecae 2 or 3 pairs, with 1 or 2 often multiloculate diverticula. All structures sometimes (*D. lumbricoides* and *D. anomala*) displaced one segment anteriorly by suppression of an anterior metamere but gizzards never anterior to V).

DISTRIBUTION: New South Wales (Port Macquarie and Kyogle areas and the Sydney Basin); Queensland (South of 25° S., coastal to as far west as 151° E.).

TYPE SPECIES: *Digaster lumbricoides* Perrier, 1872.

SPECIES: (NSW = New South Wales; Q = Queensland).

- |                                                       |        |
|-------------------------------------------------------|--------|
| 1. <i>D. anomala</i> Jamieson, 1970                   | Q      |
| 2. <i>D. armifera</i> Fletcher, 1887                  | NSW    |
| 3. <i>D. binnaburra</i> sp. nov.                      | Q      |
| 4. <i>D. bradburyi</i> Jamieson, 1970                 | Q      |
| 5. <i>D. brunneus</i> Spencer, 1900                   | Q      |
| 6. <i>D. gayndahensis</i> Spencer, 1900               | Q      |
| 7. <i>D. gwongorellae</i> Jamieson, 1972              | Q      |
| 8. <i>D. lamingtonensis</i> Michaelsen, 1916          | Q      |
| 9. <i>D. longmani</i> Boardman, 1932                  | NSW, Q |
| 10. <i>D. lumbricoides</i> Perrier, 1872              | NSW, Q |
| 11. <i>D. minima</i> sp. nov.                         | Q      |
| 12. <i>D. minor</i> Spencer, 1900                     | Q      |
| 13. <i>D. nothofagi</i> sp. nov.                      | Q      |
| 14. <i>D. perrieri</i> Fletcher, 1889                 | NSW    |
| 15. <i>D. pseudoperichaeta</i> sp. nov.               | Q      |
| 16. <i>Perissogaster queenslandica</i> Fletcher, 1889 | Q      |
| 17. <i>D. sexpunctata</i> sp. nov.                    | Q      |

REMARKS: Jamieson (1970) showed that the type-species of *Perissogaster*, *P. excavata* (see also Bage, 1910), and *P. nemoralis* had only astomate micromeronephridia posteriorly. The third known species, *P. queenslandica*, was shown to have the dichogastrin condition, with the medianmost nephridium enlarged and stomate. Demonstration (Jamieson, 1971b) that the dichogastrin condition was typical of *Digaster* supported the contention in the previous paper that *P. queenslandica* could be accommodated in *Digaster* while *Perissogaster*

should be revived for *P. excavata* and *R. nemoralis*. *Perissogaster* is here formally re-instated although it must be stated that existing material of the genus is not in sufficiently good condition to allow full characterization of the genus.

With the re-instatement of *Perissogaster* as an independent genus, the number of di- or tri-gastric genera in the Megascolecinae is raised to thirteen of which only *Digaster*, *Didymogaster* and *Perissogaster* are Australian. The fact that all thirteen genera have the advanced (meronephric) condition of the nephridia, all holonephric megascolecines being monogastric or agastric, suggests that multiplication of gizzards is a secondary condition, at least in the Megascolecinae. Ten of the genera with multiplied gizzards (*Benhamia*, *Dichogaster*, *Eudichogaster*, *Eutrigaster*, *Lennogaster*, *Millsonia*, *Omodeona*, *Pellogaster*, *Rillogaster* and *Trigaster*) differ from the three Australian genera in lacking the megascolecine of the male terminalia (pores of a pair of prostates and of the vasa deferentia combined on XVIII). This difference, in addition to its diagnostic value, is of interest in suggesting that multiplication of the gizzards has occurred in Australia independently of replication in groups in other regions. This inference is supported by the fact that the primitive (that is, holonephric, monogastric) Australian genera have the same, megascolecine condition of the male pores, a fact which suggests that they are ancestral to the di- or tri-gastric Australian genera and contraindicating descent of the latter from allopatric genera with non-megascolecine male pores whether with one or more gizzards.

The five new species of *Digaster* and two new subspecies are all assignable to the very homogeneous *lumbricoides* species-group defined by Jamieson (1971b). Inclusion of the remaining species, *D. armifera*, *D. perrieri* and *D. queenslandica*, in the genus confers greater heterogeneity on the genus but their exclusion cannot on present evidence be justified. The displacement of the gizzards in the *lumbricoides* group from VI and VII to V and VI in *D. lumbricoides* and *D. anomala* by deletion or suppression of an anterior metamere, together with occurrence of gizzards in V, VI and VII in the morphologically close *D. queenslandica* and (Jamieson, 1963) a variant in *D. perrieri*, do not allow convincing subdivision on the basis of distribution of the gizzards.

*Perissogaster* s. strict., now limited to *P. excavata* and *P. nemoralis*, from New South Wales, is diagnosed from all other megascolecids by the combination of three gizzards, megascolecine male pores and non-dichogastrin (megascolecine) nephridia. *Didymogaster*, also from New South Wales,

is distinguished by the combination of two gizzards, in VI and VII, megascolecine male pores, the segmental (not intersegmental) location of the spermathecal pores and the suboesophageal testisacs.

While the tribes Perionychini and Dichogastrini, characterized by holonephric and dichogastrin nephridia respectively, are acceptable groupings by virtue of their homogeneity, the tribe Megascolecini, diagnosed by non-dichogastrin meronephridia, which includes *Perissogaster*, is less satisfactory, being more heterogeneous in morphology and probably in origin. Relegation of *Perissogaster* s. strict. to the Megascolecini still leaves the possibility of close relationship of this genus with *Digaster*.

The distribution of *Digaster* (like that of *Didymogaster* and *Perissogaster*) conforms with the montane coastal province of the Eastern Subregion of Australia recognized for the avifauna by Kikkawa and Pearse (1969; see Jamieson, 1974). In view of the large number of very similar species in the genus, this limited geographical distribution does not appear to be evidence, as might have been thought, that *Digaster* is a relict genus with a former wide distribution in Australia. If it were taken to be a relict with a much-contracted distribution it would be necessary to explain why the similarly digastric *Didymogaster* and the tri-gastric *Perissogaster* also survived only in this province. Nor can the limited distribution be explained in terms of recent introduction from outside Australia for this would require either concomitant introduction of all its species and, presumably, of *Didymogaster* and *Perissogaster*, or massive speciation since introduction. It seems more acceptable that *Digaster* (and the clearly related *Didymogaster* and the less certainly related *Perissogaster*) originated locally from monogastric holonephric worms, or their meronephric descendants, sufficiently long ago for considerable speciation but not long enough ago for colonization of other parts of Australia. Part of the restriction in range must be due to ecological preferences and not to lack of time for dispersion but it must be reiterated that the digastric condition suggests relatively recent, and local, origin of the genus for reasons given above.

#### KEY TO THE SPECIES AND SUBSPECIES OF *Digaster*

1. 3 oesophageal gizzards present . . . . .  
    . . . . . *D. queenslandica*\*
2. 2 oesophageal gizzards present . . . . . 2
2. Male pores in XVII . . . . . 3  
    Male pores in XVIII. . . . . 4
3. Accessory genital markings a pair of oval

- glandular areas in front of and behind the male pores, posteriorly in XVI and anteriorly in XVIII. Other accessory genital markings absent . . . . .
- . . . *D. lumbricoides lumbricoides*, Fig. 9F
- Accessory genital markings midventral, unpaired transverse pads in 19/20 and 20/21; sometimes also in varying numbers of intersegments 18/19, 21/22–24/25, and in 8/9–10/11 . . . . . *D. anomala*, Fig. 9B
4. Gizzards in V and VI. . . . . 5  
Gizzards in VI and VII . . . . . 6
  5. A square glandular pad midventral in each of XI and XII. At maturity, 2 elliptical genital markings, one behind the other, lateral of the male pores. A pair of ellipses often present in each of XVII and XIX . . . . .  
. . . . . *D. armifera*\*, Fig. 9C
  - Genital markings absent from XI and XII. 3 transverse ventral ridges typically present, in 17/18, XVIII and 18/19 . . . . . *D. perrieri*\*
  6. Dorsal setal couples (*cd*) in caudal segments displaced far dorsally, the 4 setae in 4 equispaced lines . . . . . 7  
Dorsal setal couples not displaced far dorsally; significantly further apart than the setae of each couple . . . . . 8
  7. Accessory genital markings a midventral pad in X, XVI and XVII, and a pair of white tumescences presetally in XIX . . . . .  
. . . . . *D. pseudoperichaeta*, Fig. 7
  - Accessory genital markings a midventral circular papilla in XIII, XX, XXI and in varying numbers of segments XII, XV, XVI, XIX, and XXII–XXIV. A paired marking sometimes present in X . . . . .  
. . . . . *D. minima*, Fig. 6A
  8. One or more midventral unpaired genital markings (papillae or transverse pads) in or within a segment or two of IX . . . . . 9  
Midventral unpaired genital markings absent or, if present, not in the vicinity of IX . . . . . 13
  9. 3 pairs of small disc-like markings located between the male porophores on XVII . . . . .  
. . . . . *D. sexpunctata*, Fig. 8
  - No genital markings between the male porophores . . . . . 10
  10. Metandric (testes and funnels in XI, seminal vesicles 1 pair, in XII only). First dorsal pore in 5/6 or 6/7 . . . . . *D. longmani* (part.)  
Holandric (testes and funnels in X and XI, seminal vesicles 2 pairs, in IX and XII or XI and XII). First dorsal pore in 4/5 . . . . . 11
  11. Seminal vesicles in XI and XII. First dorsal pore in 5/6 . . . . . *D. longmani* (part.)  
Seminal vesicles in IX and XII. First dorsal pore in 4/5 . . . . . 12
  12. Midventral unpaired papillae transversely elongate on segments following the spermathecal pores; intersegmental in the vicinity of the male pores where there may be paired papillae also . . . . . *D. nothofagi*, Fig. 6B  
Midventral unpaired papillae circular or longitudinally extended on segments following and often including the spermathecal pores; not present in the vicinity of the male pores where there are usually paired segmental markings . . . . . *D. binnaburra*, Fig. 2
  13. A midventral circular, oval or almost bifid pad on XVIII between or including the male pores . . . . . 14  
No midventral pad in XVIII. Genital markings usually present elsewhere . . . . . 15
  14. Female pore unpaired. No genital markings present in addition to that on XVIII . . . . .  
. . . . . *D. gwongorellae*, Fig. 9E  
Female pore paired. Typically with an additional genital marking on XIX . . . . .  
. . . . . *D. minor*\*, Fig. 9D
  15. Metandric (testes and funnels in XI, seminal vesicles in XII only) . . . . . 16  
Holandric (testes and funnels in X and XI, seminal vesicles 2 pairs, in IX and XII or XI and XII) . . . . . 18
  16. Unpaired transverse midventral pads intersegmental on the clitellum. First dorsal pore in 9/10–12/13 . . . . .  
. . . . . *D. brunneus* (part.), Fig. 4B  
Clitellar pads absent. First dorsal pore in 5/6–12/13 . . . . . 17
  17. First dorsal pore in 9/10 or further posteriorly . . . . . *D. brunneus* (part.), Fig. 3B  
First dorsal pore in 5/6 or 6/7 . . . . .  
. . . . . *D. longmani* (part.)
  18. A pair of glandular patches present in the vicinity of 17/18 in front of the male pores. Other genital markings present or absent . . . . . 19  
No paired glandular patches anterior to the male pores. Male pores in *ab* of XVIII on small papillae within a common lip-like ridge. Midventral unpaired transverse pads extending to *ab* in 19/20, 20/21 and 21/22 . . . . . *D. gayndahensis*\*, Fig. 9G
  19. A pair of genital markings in or just anterior to 17/18 and a similar, unilateral (left) marking in or just anterior to 18/19. First dorsal pore in 5/6. Spermathecal ducts not dilated . . . . .  
. . . . . *D. lamingtonensis*\*, Fig. 9H  
Paired markings in or near 17/18; markings if present near 18/19 paired. First dorsal pore in 4/5 or 8/9–10/11. Spermathecal ducts not

dilated . . . . . 20	areas but paired markings behind the pores indistinct or absent. . . . . 21
20. First dorsal pore in 4/5. Male pores preceded at 17/18 and succeeded at 18/19 by a pair of oval glandular areas . . . . .	21. Body approximately 90–140 mm long and 4–5 mm wide . . . <i>D. bradburyi bradburyi</i> , Fig. 9A
. . . . . <i>D. lumbricoides kondalilla</i> , Fig. 5	Body approximately 185–265 mm long and 8–10 mm wide . . . . .
First dorsal pore in or behind 8/9. Male pores preceded at 17/18 by a pair of glandular . . . . .	. . . . . <i>D. bradburyi bunyaensis</i> , Fig. 3A

\* Asterisked species have not been recorded, and are therefore not described, in this study. Published illustrations of their genital fields are, however, reproduced. The fields of *D. perrieri* (see Jamieson, 1963) and *D. queenslandica* (see Fletcher, 1889) on available specimens do not merit illustration.

### *Digaster anomala* Jamieson, 1970

Figs. 1, 9B; Table 1

*Digaster anomala* Jamieson, 1970, pp. 40–3, figs. 1B, C; 2D, E.

MATERIAL EXAMINED: *Or 3*, 152°50'E. 27°15'S., Kobbie, rocky hillside covered by Lantana, E. Bradbury, 10 Jul 1970 and 10 Aug 1970, BM(NH) 1973.10.1-5, 6-15; rocky hillside by road, E. Bradbury, 8 Oct 1970, BM(NH) 1973.10.16-21. *Or 5*, 152°45'E. 27°21'S., 6 miles from Mt. Nebo on Mt. Glorious road, on side of eucalypt-covered hill by ferns and nettles, E. Bradbury, 12 Jun 1970, BM(NH) 1973.10.22-23; Mt. Glorious, rainforest, E. Bradbury, 12 Jun 1970, BM(NH) 1973.10.24; 8 Oct 1970 BM(NH) 1973.10.25; I. Naumann, 13 Sep 1971, BM(NH) 1973.10.26. *Or 7*, 152°47'E. 27°23'S., Mt. Nebo road Mt. Nebo, in loamy soil in gully in eucalypt area, E. Bradbury, 12 Jun 1970, 3, Jamieson collection; 1 mile from Mt. Nebo on road, E. Bradbury, 10 Aug 1970, BM(NH) 1973.10.27-28. *Or 11*, 152°54'E. 27°28'S., Gold Creek Road, Brookfield, in loose damp soil in leaf mould near creek, E. Bradbury, 24 Apr 1970, BM(NH) 1973.10.29-44, 45. *Or 12*, 152°54.5'E. 27°30'S., Willunga Street, Brookfield, on dirt road surface after heavy rain, B. Jamieson, 9 Dec 1970, BM(NH) 1973.10.46-55; Brookfield, E. R. Johnson, no date, BM(NH) 1973.10.56. *Or 13*, 152°51'E. 27°32'S., banks of Kholo Creek, Mt. Crosby Road, near Brisbane, B. Jamieson and/or E. Bradbury, 13 Mar 1970, 24 Apr 1970, 2 Feb 1970, 4 Mar 1970, 2 Jun 1966, BM(NH) 1973.10.57, 58-59, 60-65, 66-67, 68-70. *Or 14*, 152°53'E. 27°35'S., Moggill, near Brisbane, E. R. Johnson, no date, BM(NH) 1973.10.71-72. *Or 16*, 152°58'E. 27°28'S., Eastern part of Mt. Coot-tha, Brisbane, in sandy *Lantana* soil, L. Lyndon, 5 Sep 1971, BM(NH) 1973.10.73-74. *Or 18*, 152°58'E. 27°33'S., Fig Tree Pocket, Brisbane, cleared land near river bank, Mrs C. C. Wallace, 27 Oct 1969, QM G8316-24. *Or 20*, 152°49'E. 27°49'S., Mt. Flinders, H. Mayne, no date, BM(NH) 1973.10.75-77, 78.

The following account is abstracted from Jamieson (1970). New material is listed under 'Material Examined' and is discussed under 'Genital Field Variation', below.

l = 69–105 mm, w (midclitellar) = 3–4 mm, s = 103–146. Unpigmented excepting the brick red clitellum. Prostomium epilobous. First perforate dorsal pore 4/5. Setae in 8 longitudinal rows

throughout; commencing on segment I; *aa:ab:bc:cd:dd* in XII averaging 2.9:1.4:3.3:0.19:6; *dd:u* = 0.47–0.55. Clitellum annular, XIII–XVII. Male pores on XVII in *a*. Accessory genital markings midventral unpaired transverse pads in 19/20 and 20/21 and sometimes also in 18/19, 21/22, 23/24 and 24/25; sometimes with slight ventral epidermal elevations in some or all of intersegments 8/9–10/11. Female pores antero-median of seta *a* in XIII. Spermathecal pores 2 pairs, well median of *a* lines, in 6/7 and 7/8.

Last hearts in XII. Gizzards in V and VI; calciferous glands absent; intestinal origin XVII. Nephridia meronephridia with exonephric tufts in III and, caudally, an exonephric stomate megameronephridium median to astomate micromeronephridia in each segment. Holandric; testes in IX and X; seminal vesicles racemose in VIII or VIII and XI. Ovaries in XII; ovisacs absent. Prostates bipartite, in XVII. Spermathecae 2 pairs, in VII and VIII; diverticulum large, ovoid-subspherical, internally multiloculate, almost sessile on the ectal end of the duct; length of a spermatheca = 3.0 mm; ratio of length: length duct = 3.5; ratio of length: length diverticulum = 4.7.

GENITAL FIELD VARIATION: Specimens from the type-localities (including the new material from *Or 12*, Willunga Street, and *Or 13*, Kholo Creek) differ from material from all other recorded localities in having the spermathecal pores median to setal lines *a*, not in or lateral of *a*. These two alternative conditions may, for convenience in discussion, be said to characterize a typical and an atypical population, respectively. Table 1 lists the distribution of transverse genital markings in 31 typical specimens, including the holotype and 11 paratypes as described by Jamieson (1970), and in 30 atypical specimens from all localities sampled. It is seen that in the typical population transverse genital markings are present in a few to most of intersegments 6/7–11/12, 15/16, 16/17–24/25. The distribution in the atypical population agrees with this except for absence in 11/12, 16/17 and 22/23–24/25. These absences in atypical specimens

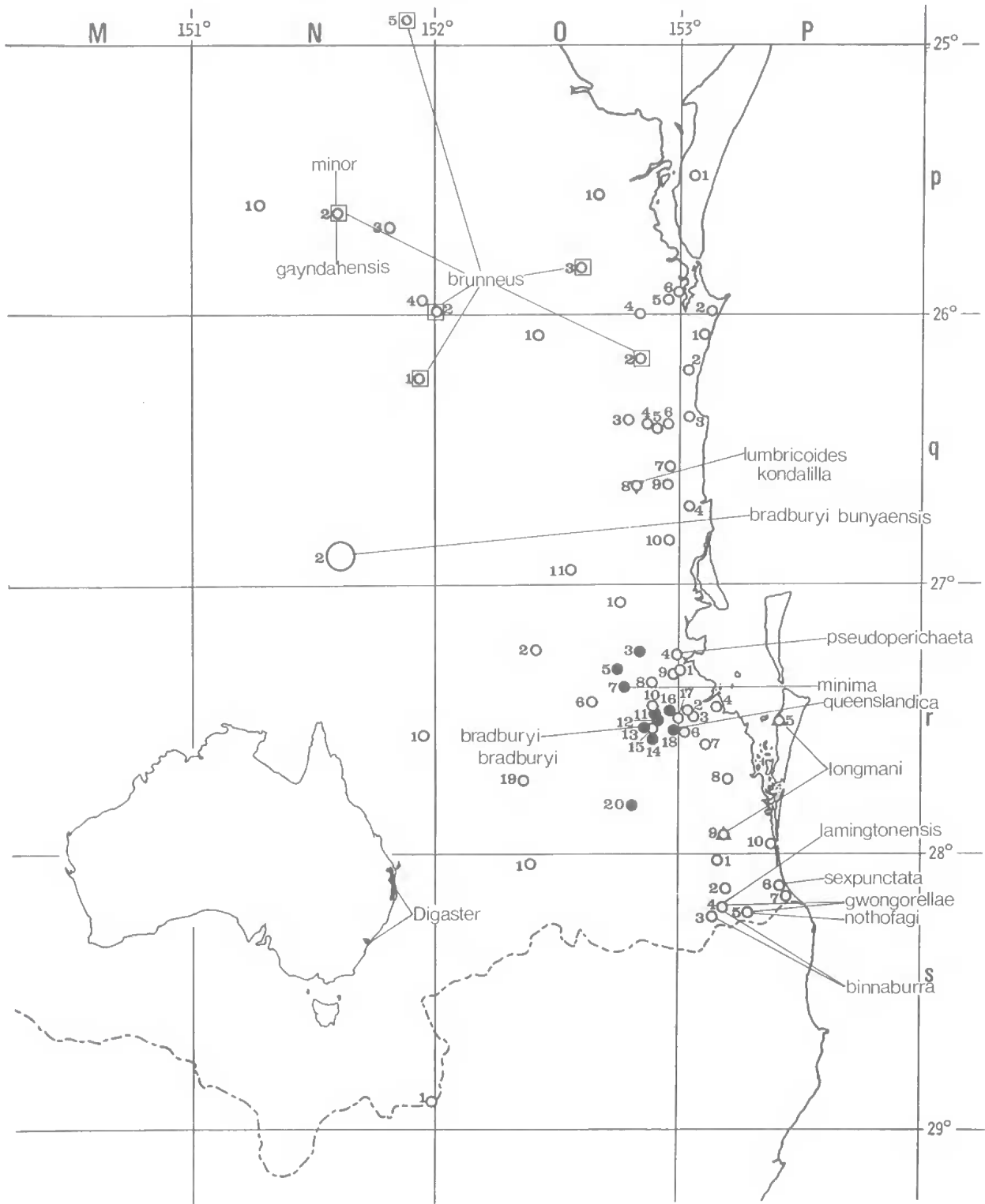


FIG. 1: Queensland records of *Digaster*. ● = *D. anomala*. Other species shown by labelled symbols. Unlabelled blank circles indicate sampled localities which did not yield *Digaster*. Localities are referred to in the text by co-ordinates and number (e.g. Or 3). The inset shows the Australian distribution of this endemic genus.

may not represent a significant difference as the frequency of markings at these sites is low in the typical specimens. In both populations the genital markings are most frequent in 19/20–20/21, being virtually constant in 19/20 and very frequent in 20/21. Good agreement between the two populations is seen in the frequency of 23–26% in the occurrence of a marking in 21/22 but a major difference is seen in the frequency in 17/18 and 18/19, for in the typical population the marking is more frequent in 17/18 (55%) than in 18/19 (19%) whereas in the atypical population the frequency is reversed, 13% in 17/18 against 83% in 18/19. A further difference is that the marking in 18/19 when present is always simple in the typical specimens while it is usually composed of a pair of more or less conjoined ellipses in the atypical specimens. Penial setae have not been observed in typical specimens whereas in the atypical population in 19 specimens examined for penial setae they were present in 13 specimens (BM(NH) 1973.10.1, 6, 7, 16, 17, 25, 27, 30, 45, 74. Jamieson collection, Mt. Nebo), though absent in 6 specimens (BM(NH) 1973.10.22, 23, 56, 71, 75, 78). All specimens show the *anomala* condition, apparent suppression of the first metamere so that segment I is setigerous and structures including the ovaries and prostates are displaced one segment anteriorly relative to their position in most Megascolecinae.

TABLE 1: DISTRIBUTION OF GENITAL MARKINGS IN THE *Digaster anomala* COMPLEX.

Intersegment occupied	Number of specimens			
	Typical population (of 31)	%	Atypical population (of 30)	%
6/7	17	54.8	11	36.6
7/8	17	54.8	11	36.6
8/9	10	32.3	1	3.3
9/10	10	32.3	1	3.3
10/11	6	19.4	1	3.3
11/12	3	9.7	0	0
12/13	0	0	0	0
13/14	0	0	1	3.3
14/15	0	0	1	3.3
15/16	1	3.2	2	6.7
16/17	6	19.4	7	0
17/18	17	54.8	4	13.3
18/19	6	19.4	25	83.3
19/20	31	100	29	96.7
20/21	28	90.3	24	80.0
21/22	8	25.8	7	23.3
22/23	1	3.2	0	0
23/24	3	9.7	0	0
24/25	2	6.5	0	0

TYPE-LOCALITY: Brisbane (Gap Creek Road and Willunga Street, Or 12; Kholo Creek, Or 13).

REMARKS: The anomalous segmentation, with male pores on XVII, together with the presence of a transverse genital marking in 19/20 and usually in 20/21, distinguish *D. anomala* from all other species of *Digaster*, though the same segmental anomaly occurs in the nominate subspecies of *D. lumbricoides*. The term '*D. anomala* complex' is here proposed for the combined typical and atypical populations as defined above. That the two populations are conspecific remains to be confirmed but they are clearly very closely related and if specifically distinct would have to be considered sibling species.

***Digaster binaburra* sp. nov.**

Figs. 1; 2; 10A, B; 11A; Table 2, 3

MATERIAL EXAMINED: Lamington National Park, South Queensland: *Ps* 4, 153°11'E. 28°12'S: 3 miles from Binna Burra, in rainforest with Casuarinas, B. Jamieson and E. Bradbury, 25 Mar 1970, Holotype(H) QM G7382, Paratypes (P) 1-6 (clitellate), P7-11 (with genital markings but acitellate), QM G7383-93; Binna Burra, in *Tristania-Casuarina* and mixed broadleaf forest, with tree ferns and palms, B. Jamieson and E. Bradbury, 25 Mar 1971, P14-17, 29, BM(NH) 1973.10.79-82, 83; Binna Burra, rainforest, B. Jamieson and E. Bradbury, 24 Mar 1971, P19, 20 (clitellate), 21-25 (with genital markings but acitellate), BM(NH) 1973.10.84-85, 86-90. *Ps* 3, 153°09'E. 28°14'S., in park near O'Reilly's Guest House: at Elbana Falls, B. Jamieson, 3 May 1970, P18, BM(NH) 1973.10.91; in rainforest, B. Jamieson and T. Walker, 18 Mar 1972, P12, 13, BM(NH) 1973.10.92-93; B. Jamieson, 19 Mar 1972, P26-28, BM(NH) 1973.10.94-96.

l = 62-65 mm. w (midclitellar) = 3 mm, s = 188,185 (H,P1). Form circular in cross section throughout; moderately slender; lacking strong secondary annulation. Pigmentless, excepting the brick-red clitellum, in alcohol. Prostomium propilobous; no canaliculi present dorsally or ventrally on it or the segments. First dorsal pore 4/5; pores inconspicuous. Setae in 8 regular longitudinal rows, commencing on II; setae *a* and *b* absent in XVIII. Nephropores not externally visible. Clitellum annular, XIV-XVII(H), ½ XVIII(P1), with weak extension to ½ XIII; intersegmental furrows and dorsal pores obscured excepting at 13/14 and 17/18; setae retained. Male pores minute in *ab* of XVIII, each at the centre of a small, low, circular porophore which at maximum development (P1) fills the segment longitudinally. Accessory genital markings small inconspicuous transversely oval pads paired postsetally in XVII, XIX (H,P1) and XX(H), in *ab*; the markings and

the male porophores contained within a ventral glandular area. Unpaired low boss-like accessory genital markings present anteriorly, a postsetal marking in each of VIII(H), IX and X(H,P1) and a presetal marking in IX and XI (H) or X (P1). Female pores small but distinctly visible antero-medial of *a* of XIV, about  $\frac{1}{3} qa$  apart. Spermathecal pores 2 pairs, in 7/8 and 8/9, in *a* lines on small papillae (H), or in *a* and *ab* respectively (P1).

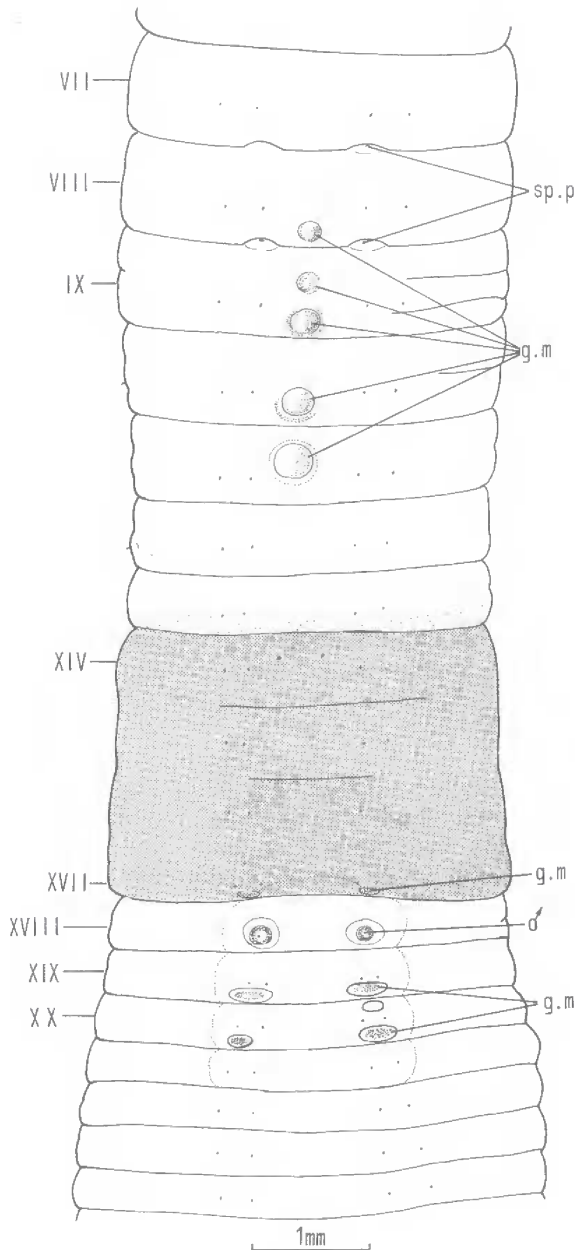


FIG. 2. *Digaster binnaburra* sp. nov. Genital field of holotype. For key to abbreviations, see Fig. 9.

Some preclitellar septa thickened; 10/11 the thickest, moderately strongly thickened. Dorsal blood vessel single, continuous onto the pharynx. Last hearts in XII, those in X–XII latero-oesophageal, each with a connective from the dorsal and the supra-oesophageal vessel. Supra-oesophageal vessel present but extent indeterminate as it is indistinctly delimited from the roof of the oesophagus. Subneural absent. Oesophagus in V thinwalled but fusiform and glossy and therefore gizzardlike in appearance, hidden by septal glands. Two strong slightly elongate spherical gizzards, each with anterior rim, in VI and VII, separated by a short region of unmodified oesophagus. Oesophagus almost suppressed, by backward extension of the gizzards, in VIII and IX; short in X–XII; swollen and vascularized in XIII–XVII, especially in XIV(P1), XV and XVI(H,P1) in each of which it has a reniform but not separate dilatation on each side which is slightly bilobed owing to a circumferential vessel which arises from the closely adherent dorsal vessel. Parallel sinuous rugae present on the internal wall of the oesophagus in XV and XVI but no true extramural calciferous glands present. Intestinal origin XIX; typhlosole, caeca and muscular thickening absent. Nephridia meronephridia: small tufts in II, III and IV sending a common composite duct on each side to the peristomium near the mouth; large tufts in V sending a composite (exonephric) duct to the region of segment II(H,P1) where (P1) it appears to continue to the wall of the pharynx. Thereafter with lateral bands of numerous astomate, exonephric micromeronephridia. In the anterior intestinal region with 8 such nephridia on each side; caudally with the medianmost nephridium enlarged as an exonephric megameronephrium with preseptal funnel. Holandric; gymnorchous (sperm funnels iridescent in X and XI); seminal vesicles racemose, in IX and XII. Prostates racemose, tongue-shaped, that on the left in the holotype consisting of adpressed dorsal and ventral halves; vas deferens joining the short, muscular medianly directed duct at its junction with the gland. Penial setae absent. Metagnynous; ovaries, consisting of several strings of oocytes, and funnels in XIII; ovisacs not recognizable. Spermathecae 2 uniform pairs; ampulla elongate ovoid; duct cylindrical, bearing an iridescent rounded multiloculate diverticulum at its ectal extremity; length of right spermatheca of VIII (H) = 1.7 mm; ratio of length spermatheca: length duct = 2.4; ratio of length spermatheca: length diverticulum = 5.8.

REMARKS: The midventral anterior genital markings which, like the paired markings in the male



TABLE 2: GENITAL MARKINGS IN 18 SPECIMENS OF *Digaster binnaburra*.

		Specimen*	Total
Midventral markings			
VI	Presetal	—	0
	Postsetal	P13, 18	2
VII	Presetal	—	0
	Postsetal	P12-14, 17-20, 26, 28	9
VIII	Presetal	P3, 13-14, 17-20, 26	8
	Postsetal	H, P12-15, 17-20, 26, 28	12
IX	Presetal	H, P3, 12-15, 17-20, 26-28	13
	Postsetal	H, P1-5, 12-15, 18-20, 26-28	16
X	Presetal	P1-5, 12-15, 17-20, 26-28	16
	Postsetal	H, P1-5, 12-20, 26-28	18
XI	Presetal	H, P1-5, 12-15, 17-20, 26-28	17
	Postsetal	P2-5, 12-20, 26-28	16
XII	Presetal	P5, 19	2
	Postsetal	—	0
Paired markings in <i>ab</i>			
XVIII	Postsetal	H, P1-4, 12-13, 16-20, 26	13
XIX	Postsetal	H, P1-4, 12-20, 26-28	17
XX	Presetal	H (left), P17, 26	3
	Postsetal	H, P12-13, 16, 18, 27, 28	7
XXI	Presetal	P26	1
	Postsetal	P26	1

\*H = Holotype, P = paratype.

field, are present in partly mature a clitellate and in clitellate specimens, permit ready diagnosis of *D. binnaburra*. The postsetal markings in X are constant in the type sample and are almost invariably accompanied by markings postsetally in IX, presetally in X, and pre- and post-setally in XI. Some fusion of presetal and postsetal markings is common.

#### *Digaster bradburyi* Jamieson, 1970

*Digaster bradburyi* Jamieson, 1970, pp. 35-40, figs. 1A, 2A-C, 3.

The following account is based on Jamieson (1970) and new material, comprising a new subspecies, from Bunya Mountains.

l = 88-265 mm, w (midclitellar) = 4-10 mm, s = 116-269. Body slender, circular in cross section throughout, pigmentless or pale brown, clitellum pigmented purplish brown. Prostomium epilobous (or sometimes prollobous?). First dorsal pore 8/9, 9/10 or 10/11. Setae in eight longitudinal rows throughout, commencing on II; minute and not, or only sporadically visible in the forebody, conspicuous on the clitellum owing to pale encircling fields; *aa:ab:bc:cd:dd* in XII (measured for nominate subspecies only) averaging 3.9:1.3:3.2:7:13.5;

*dd:u* = 0.41-0.45; *c* and *d* not especially dorsal posteriorly. Nephropores not externally recognizable. Clitellum annular, XIII,  $\frac{1}{2}$ XIII, XIV-XVIII,  $\frac{1}{3}$ ,  $\frac{1}{2}$ XIX (= 5 $\frac{2}{3}$ -6 $\frac{1}{3}$  segments) but its pigmentation may reach XII-XX. Male pores on XVIII in *a* or *ab*. Accessory genital markings an approximately oval glandular marking occupying the postsetal portion of XVII and extending over intersegment 17/18 slightly median or slightly lateral of the male pores. One or two pairs of less distinct markings present behind the male pores, in XVIII and/or XIX, or absent. Female pores anteromedian to setae *a* of XIV. Spermathecal pores 2 pairs, in 7/8 and 8/9, in *a* lines.

Dorsal blood vessel continuous onto the pharynx. Last hearts in XII; those in X-XII latero-oesophageal, each receiving a connective from the dorsal vessel and from a poorly or well defined supra-oesophageal vessel; subneural vessel absent. Gizzards in VI and VII, not separated by unmodified oesophagus. Extramural calciferous glands absent. Intestinal origin  $\frac{1}{2}$  (or anterior?) XVIII; typhlosole, caeca and muscular thickening absent. Nephridia meronephridia: tufts in II-VI; those in IV-VI, at least, enteronephric. Holandric; testes in X and XI; seminal vesicles racemose, in IX and XII. Ovaries in XIII; ovisacs absent. Prostates

bipartite, in XVIII; penial setae absent though follicles *a* and *b* may be present in the male porophores. Spermathecae 2 approximately equisized pairs, in VIII and IX, though the ampullae may be displaced into the preceding segment, each with an approximately ovoid ampulla and a well demarcated, dilated duct which is widest slightly ectal of its midlength and bears, at or ental of its widest part, 1 or sometimes 2 bulb-shaped, externally simple diverticula; length of a spermatheca 2.4–4.0 mm; ratio of length spermatheca: length duct = 1.9–2.8; ratio of length spermatheca: length diverticulum = 4.9–6.2.

TYPE-LOCALITY: Kholo Creek, near Brisbane (Or 13).

WIDER DISTRIBUTION: Bunya Mountains (Nq 2).

***Digaster bradburyi bradburyi* Jamieson, 1970**  
Figs. 1; 9A

*Digaster bradburyi* Jamieson, 1970, pp. 35–40, figs. 1A, 2A–C, 3.

MATERIAL EXAMINED. *Or* 13, 152°51'E. 27°32'S., Kholo Creek at Ugly Gully, E. Bradbury, 10 May 1970, 4 specimens, BM(NH) 1973.10.112–115.

For detailed account see Jamieson (1970). Characters as for specific description, above, with *l* = 88–140 mm, *w* (midclitellar) = 4–5 mm. Body, excepting clitellum, pigmentless. Prostomium epilobous  $\frac{1}{5}$ – $\frac{1}{3}$ . Clitellum  $\frac{1}{2}$  XIII, XIV–XVIII,  $\frac{1}{3}$ ,  $\frac{1}{2}$  XIX (= 4–6 segments). Male pores in *ab*. Accessory genital markings a pair of approximately

oval, sunken, translucent markings occupying the postsetal portion of XVII and intersegment 17/18 only; slightly median to the male pores.

Supra-oesophageal very well developed. Intestinal origin  $\frac{1}{2}$  XVIII. Nephridial tufts in IV sending a composite duct on each side to the lateral extremity of the mouth; those in V and VI to pharynx behind brain. Ectal portion of spermathecal duct dilated and joined entally by diverticulum; length spermatheca = 2.4–3.6 mm; ratio length: length duct = 1.9–2.8; ratio length: length diverticulum = 4.9–7.8.

TYPE-LOCALITY: Kholo Creek, near Brisbane (Or 13).

REMARKS: Of the above characters, the only significant differences from the second subspecies appear to be the smaller size, perhaps effluence of the tufted nephridia of V and VI into the pharynx and not into the buccal cavity into which those in III–VI discharge in the Bunya specimens, and possibly the unpigmented body.

***Digaster bradburyi bunyaensis* subsp. nov.**  
Figs. 1; 3A; 10C, D; 11B.

MATERIAL EXAMINED: *Nq* 2, 151°35'E. 26°57'S., Bunya Mountains National Park, in mixed rainforest at c.1000 metres, B. Jamieson and E. Bradbury, 20 Feb 1971, Holotype (H), QM G8333; Paratype (P) 1, BM(NH) 1973.10.97; P2, QM G8334; P3, Jamieson collection.

*l* = 185 (P1), 265 (H) mm, *w* (midclitellar) = 8.0 (P1), 9.6 (H) mm, *s* = 231 (P1), 237 (H). Secondary

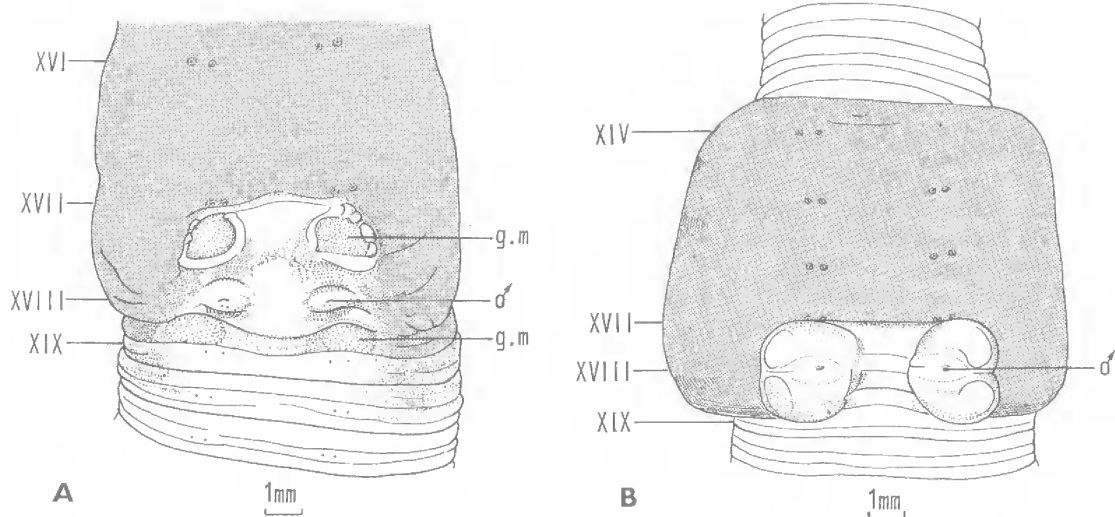


FIG. 3: A, *Digaster bradburyi bunyaensis* subsp. nov. Genital field of holotype. B, *D. brumeus* Spencer, 1900, specimen from Wolvi, BM(NH) 1973.10.105; the clitellum is shown widened owing to dorsal incision. For key to abbreviations, see Fig. 9.

TABLE 3: INTERSETAL DISTANCES IN SEGMENT XII IN *Digaster*

Species	Intersetal distance, mm								Standardized as % of periphery							
	aa	ab	bc	cd	dd	dc	cb	ba	aa	ab	bc	cd	dd	dc	cb	ba
<i>D. binnaburra</i>																
Holotype	0.9	0.3	1.3	0.7	3.4	0.7	1.2	0.3	10.1	2.8	14.2	8.5	39.7	8.5	13.4	2.8
Paratype 1	0.8	0.3	1.2	0.8	3.0	0.8	1.1	0.3	9.3	3.1	14.9	9.9	36.5	9.3	13.6	3.4
Mean									9.7	3.0	14.5	9.2	38.1	8.9	13.5	3.1
Interval/ab									3.3	1.0	4.9	3.1	12.8	3.0	4.5	1.1
<i>D. lumbricoides kondalilla</i>																
Holotype	1.1	0.3	1.1	0.9	4.2	1.1	1.1	0.4	10.9	3.1	11.1	9.0	40.8	10.2	11.1	3.9
Interval/ab									3.6	1.0	3.6	2.9	13.3	3.3	3.6	1.3
<i>D. minima</i>																
Holotype	0.5	0.2	1.3	0.2	1.0	0.2	1.3	0.2	10.8	3.4	26.9	4.0	20.6	4.0	26.9	3.4
Interval/ab									3.2	1.0	7.9	1.2	6.0	1.2	7.9	1.0
<i>D. nothofagi</i>																
Holotype	1.3	0.3	1.3	0.7	2.1	0.7	1.3	0.2	16.3	3.4	16.5	9.2	26.4	8.8	16.3	3.1
Interval/ab									4.8	1.0	4.8	2.7	7.7	2.6	4.8	0.9
<i>D. pseudoperichaeta</i>																
Holotype	0.8	0.3	1.0	0.3	2.3	0.3	1.3	0.3	12.9	4.0	15.3	4.8	34.5	4.4	19.3	4.8
Paratype 1	1.1	0.3	1.4	0.4	1.4	0.3	1.5	0.3	15.6	4.7	21.1	6.3	21.1	4.7	21.9	4.7
Mean									14.2	4.4	18.2	5.5	27.8	4.6	20.6	4.8
Interval/ab									3.3	1.0	4.2	1.3	6.4	1.1	4.7	1.1
<i>D. sexpunctata</i>																
Holotype	1.2	0.4	1.3	0.7	6.8	0.8	1.1	0.3	9.5	3.0	10.0	5.8	54.1	6.0	9.0	2.5
Paratype	1.2	0.4	1.0	0.8	7.4	0.8	1.1	0.4	9.2	3.1	7.7	5.8	57.0	5.8	8.2	3.1
Mean									9.4	3.1	8.9	5.8	55.6	5.9	8.6	2.8
Interval/ab									3.1	1.0	2.9	1.9	18.1	1.9	2.8	0.9

annulation strongly developed but not obscuring the primary segmentation. Pigmented pale brown with the clitellum deep purplish brown. Prostomium epilobous  $\frac{1}{2}$ , closed (H); or appearing prolobous with lateral borders continued to  $1/2$  but not more conspicuous than the numerous longitudinal peristomial grooves (P1). First dorsal pore 9/10. Postclitellar setae visible with some difficulty; setae *a* and *b* in XVIII represented by two follicles behind each male pore (only a single, left, follicle in P1). Clitellum annular, XIII– $\frac{1}{3}$ XIX but continued as rosy pigmentation throughout XII and XX; interrupted in *bb* behind the setal arc of XVII; only intersegmental furrow 13/14 complete; dorsal pores occluded; setae visible. Male pores transverse slits equatorially in XVIII in *a*, on elliptical porophores. Accessory genital markings a pair of oval unelevated glandular patches posteriorly in XVII and apparently extending slightly on to XVIII (intersegmental furrow 17/18 obscured) in *ab* (all specimens), each patch (H) with a whitish laterally papillated border; a further pair of

patches presetally in XIX centred in *b* but indistinctly delimited; in P2 a pair of glandular depressions situated posteriorly in XVIII and similarly placed in XIX; each slightly extending onto the succeeding segment. Midventral and other accessory genital markings absent. Female pores approximately  $\frac{1}{2}$  *aa* apart. Spermathecal pores 2 pairs of conspicuous slits in *a* on small papillae.

Septa 8/9–11/12 very thick (6/7, 7/8 and 12/13 moderately strongly thickened). Latero-oesophageal hearts, in X–XII, each arising from the dorsal vessel and receiving a slender connective from an imperfectly differentiated supra-oesophageal vessel. Pharynx ending in IV; oesophagus narrow in V; gizzards firm but only moderately large, tubular. Oesophagus almost suppressed in VIII by backward extension of the gizzards. Nephridia (H): tufts in II–VI, increasing in size posteriorly to large in VI; those in II apparently (but not certainly) exonephric; those in II–VI enteronephric, sending composite ducts to the anterior region of the buccal cavity. Dense

lateral bands of nephridia on the posterior septum of VII are exonephric by numerous ducts which enter the body wall anteriorly in the segment; nephridia in succeeding segments less numerous, exonephric micromeronephridia on the body wall posteriorly in their segments; nephridia in anterior intestinal segments equatorial on the body wall, approximately 10 per side in each segment; caudally with a slightly enlarged exonephric megameronephridium, with preseptal funnel, median to astomate, exonephric micromeronephridia on each side. Prostate ducts bound by a muscular and fibrous covering, on each side, to the ventral body wall. Spermathecae each with an ovoid though asymmetrical ampulla and a well demarcated broadly fusiform duct which bears dorsolaterally, at its widest point, 1 or (H, right VIII) 2 bulb-shaped diverticula which are externally simple but internally have complex lumina; length of right spermatheca of VIII (H) = 4.0 mm; ratio length: length duct = 2.0; ratio length: length diverticulum = 6.2.

REMARKS: The large size of the specimens of this taxon and general morphological similarity (including location of the first dorsal pore in the vicinity of 9/10) to those specimens of *D. brunneus* which lack transverse genital markings at first suggested their close relationship, if not conspecificity with *D. brunneus*. However, it differs from *D. brunneus* but conforms with *D. bradburyi*, in dilatation of the spermathecal ducts, holandry, in the bipartite form of the prostates and in the form of the genital markings in 17/18. Though the body size is much greater than that of *D. bradburyi*, the dimensions and proportions of the spermathecae are strikingly similar, though also similar to those of *D. brunneus*. Dilatation of the spermathecal ducts and bipartite prostates are also seen in the closely similar *D. lumbricoides kondalilla* but the latter differs in location of the first dorsal pore in 4/5. It is possible that the Kondalilla specimens are closer to *D. bradburyi* than to *lumbricoides* but the uncertainty in this respect is a reflection of the especially close relationship, within the genus, of *lumbricoides* and *bradburyi* and, less closely, *brunneus* and *lamingtonensis*.

The validity of placing *bunyaensis* in *D. bradburyi* as a subspecies in the sense of a geographical race is questionable. The Bunya Mountains are geographically somewhat isolated but whether the Bunya and typical populations could interbreed if in contact is doubtful owing to their great difference in body size. If reproductively and geographically isolated they would have to be considered

separate, though very similar (sibling?) species. If, on the other hand, gene exchange is possible through as yet unknown intervening populations, with specimens intermediate in size, the grounds for separation into distinct subspecies or species might be considered lost. Taxonomic recognition of the large mountain forms seems desirable, however, on present evidence and similarities with *D. bradburyi* warrant inclusion in this species as a distinct subspecies.

***Digaster brunneus* Spencer, 1900**

Figs. 1; 3B; 4A, B; 10E-G; 11C.

*Digaster brunneus* Spencer, 1900, p. 66, pl. 12, figs. 103-5.

MATERIAL EXAMINED: *No* 5, 151°53'E. 24°55'S., 10 miles from Gin Gin, in very damp clay soil, Mrs C. C. Wallace, 7 Dec 1969, QM G8325-6. *Np* 2, 151°35'E. 27°37'S., Burnett River, Gayndah: in loam covered by weeds on river bank, E. Bradbury, 11 Mar 1970, BM(NH) 1973.10.98-99; orange orchard on river bank, E. Bradbury, 11 Mar 1970, BM(NH) 1973.10.100. *Nq* 1, 151°57'E. 26°94'S., Murgon, in shallow soil, collector and date not known, BM(NH) 1973.10.101. *Op* 2, 152°01'E. 25°59'S., 5 miles N. of Tansey, on road covered with water, E. Bradbury, 7 Feb 1971, BM(NH) 1973.10.102-104. *Op* 3, 152°36'E. 25°50'S., 1 mile south of Bauple, in dry clay soil in grassy area near creek, Mrs C. C. Wallace, 6 Dec 1969, 2 Jamieson collection, QM G8327-31. *Oq* 2, 152°50'E. 26°10'S., Wolvi, C. A. Scarlett, no date, BM(NH) 1973.10.105.

The following account is based on two Gayndah specimens, BM(NH) 1973.10.98 and 100, with some additional data from other specimens where indicated. Spencer's brief account is in agreement except where noted.

l = 210+430 mm (150 mm, Spencer); w (midclitellar) = 10-11 mm (6 mm, Spencer); s = 161+397 (Specimen 98 is a posterior amputee). Form slender, circular in cross section throughout; secondary annulation strongly developed, obscuring the primary segmentation. Pigmentless in alcohol excepting the pale chocolate-brown clitellum. Prostomium prolobous; peristomium with numerous longitudinal grooves. First dorsal pore 10/11 (with a rudiment at 9/10, specimen 100) or 11/12 (specimen 98); location not given by Spencer. Setae minute, only sporadically visible; *a* and *b* absent in XVIII. Nephropores not recognizable. Clitellum annular,  $\frac{1}{2}$ XIII(?), XIII-XIX; interrupted ventrally between and behind the male pores; intersegmental furrows weakened and laterally interrupted and other annulations well marked; dorsal pores faint; setae not visible. Male pores transverse slits equatorially in *ab* of XVIII, on elliptical porophores. Accessory genital markings

in 7 specimens (2 from No 5, 2 from Np 2 and 3 from Op 3): unpaired, midventral transverse pads in intersegments 12/13 (4 Gayndah specimens); 13/14 (7 specimens); 14/15, 15/16 and 16/17, with a similar pad posteriorly in XVII and a callus-like pad posterior to and confluent with each male porophore and crossed near its posterior border by intersegmental furrow 18/19 (6 specimens). Transverse unpaired equatorial pads illustrated in XVII, XIX and (partial) in XX by Spencer. Female pores only slightly anterior of the equator of XIV, almost contiguous medianly (specimen 98) or well separated though median to *a* (specimen 100). Spermathecal pores 2 pairs of stellate apertures, each on a small rounded tubercle, in 7/8 and 8/9, in *ab* approximately; seen to lie nearer *a* than *b* in specimen 100 where ventral setal couples are here visible; (apparently in *a* lines, Spencer).

Septa 4/5–11/12 very thick (12/13 moderately strongly thickened). Dorsal blood vessel single,

continuous onto the pharynx. Last hearts in XIII (or XII according to Spencer and in a specimen from Op 3 examined); hearts in X posteriorly latero-oesophageal, each arising from the dorsal vessel and receiving a connective from a thin supraoesophageal vessel. Commissurals in V–IX valvular, like the latero-oesophageal hearts, but differing from the latter in being dorsoventral only and in giving off a lateral branch shortly before joining the ventral vessel. Subneural vessel absent. Racemose, fatbody-like masses present in XIII and XIV lateral of the dorsal vessel in XIII and XIV (specimen 98 only). Pharynx ending in IV; oesophagus in V dilated but thin-walled; gizzards, in VI and VII, large, globose, thin-walled anteriorly, the musculature thick only in the posterior half; closely abutting; not separated by unmodified oesophagus. Oesophagus wide, moniliform and very thin-walled in VIII–XVI; narrow in XVII; lacking calciferous glands but more vascularized in

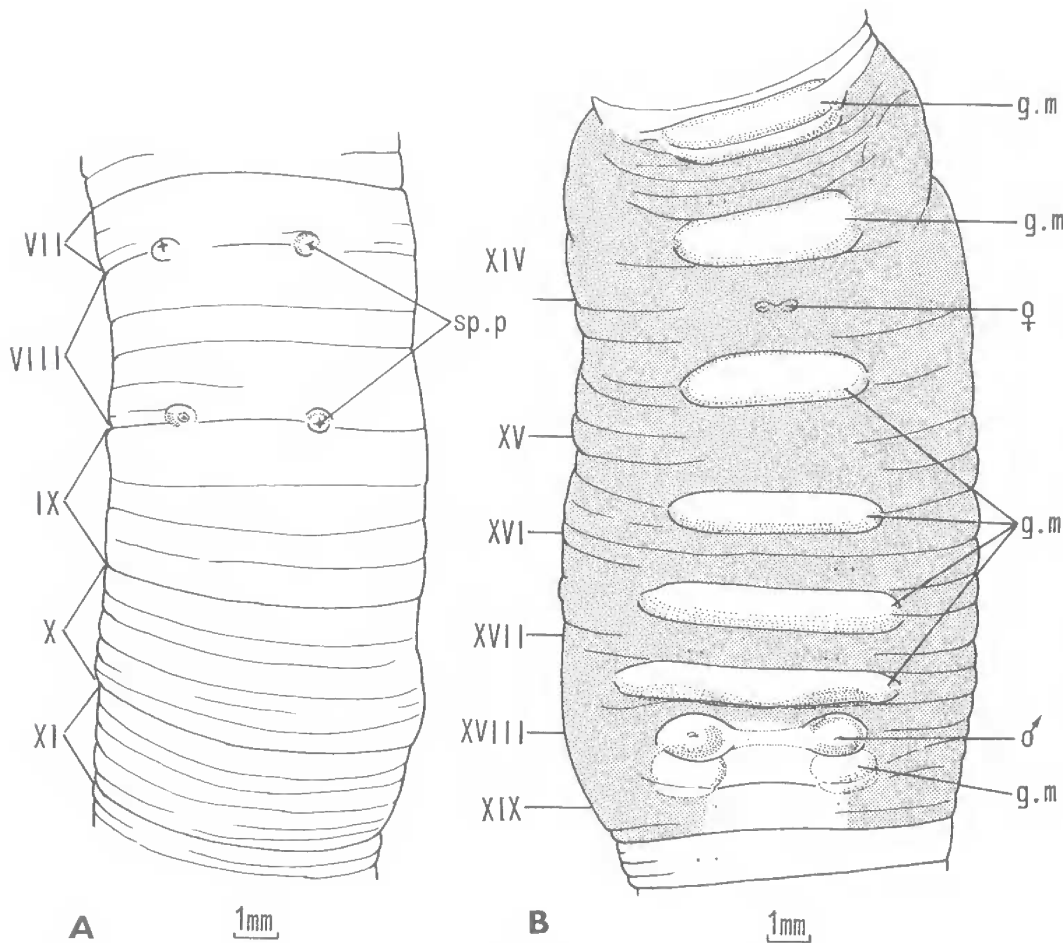


FIG. 4. *Digaster brunneus* Spencer, 1900, Gayndah specimen, BM(NH) 1973.10.98. A, Spermathecal field; B, Male genital field. For key to abbreviations, see Fig. 9.

XII–XVI than elsewhere. Intestine originating in XVIII but not greatly widening until XIX; typhlosole, caeca and muscular thickening absent. Nephridia meronephridia: tufts in II, III and IV, increasing in size posteriorly to very large in IV, adherent dorsally and laterally to the pharynx (specimens 98 and 100). The tufts in IV divisible into a dorsolateral mass discharging by several ducts directly into the pharynx and by composite ducts directly into the pharynx in III and a dorsal mass sending a composite duct forward to the wall of the buccal cavity in II (specimen 100). Thick bands of nephridia on the posterior septa of V and VI show no close association with the gut and from their peripheral position, near the body wall, may be exonephric; parietes lacking nephridia in V and VI except where a few nephridia impinge on the body wall near the septum in VI. Scattered parietal and septal exonephric micromeronephridia in VII. Nephridia in VIII–XI (specimen 98) or –XII (specimen 100) on the posterior septum and adjacent parietes with ventral aggregations; thereafter with numerous minute exonephric micromeronephridia scattered on the parietes. Caudally with numerous moderately large astomate micromeronephridia on each side all of which, in a segment, discharge into a common transverse duct which is traceable to the midline below the intestine, though enteronephry, if present, is not demonstrable; the medianmost nephridium enlarged as a stomate megameronephridium with preseptal funnel (specimen 100). Metandric (sperm funnels iridescent in XI); seminal vesicles racemose, in XII only. Metagynous, bushy ovaries, and funnels, in XIII; ovisacs not observable. Prostates racemose, not bipartite, restricted to XVIII the medianly directed duct weakly developed so that, in specimen 100 especially, the gland is almost sessile on the body wall. Penial setae absent. Spermathecae 2 uniform pairs, each with an elongate ovoid ampulla reflexed on or in line with the externally poorly differentiated slightly shorter, thicker walled duct; the duct bearing a rounded multiloculate diverticulum dorsolaterally near its ectal extremity (A very small double diverticulum reported by Spencer). Length of right spermatheca of IX = 4.0–6.2 mm; ratio length spermatheca: length duct = 2.5–2.8; ratio length spermatheca: length diverticulum = 5.3–5.9.

TYPE-LOCALITY: Gayndah (Np 2).

REMARKS: An extensive search of the Gayndah area, the type-locality, has yielded only one species which could be identified with *D. brunneus*, though, owing to the brevity of the type-description and loss of the types (Jenz and Smith, 1969), the

identification cannot be entirely certain. Spencer did not mention accessory genital markings but transverse pads are illustrated on the clitellum, on which they occur in the new material from Gayndah. The latter material agrees closely with Spencer's account in other respects including metandry which is known elsewhere in the genus only in the allopatric *D. longmani*. The distribution of the genital marking noted by Spencer, segmental in XVII, XIX and XX, differs from that in the new material in which markings are not present in XIX and XX and in which those anterior to the one in XVII are intersegmental but the fact that Spencer did not mention the markings in the text suggests that they were not closely observed and might have been overlooked anteriorly to XVII. Transverse genital markings are absent from material from Murgon (Nq 1), Tansey (Op2) and Wolvi (Oq 2) which is here identified with *D. brunneus* on general anatomy and this variation suggests that absence of markings anteriorly to XVII in the types, if real, would not necessarily exclude the new Gayndah material from the species. The specimens lacking transverse markings, although listed in 'Material Examined' above, have been excluded from the specific description pending further elucidation of their status. All are metandric with dorsal pores in 9/10–10/11, as in the new Gayndah material; hearts are in XII (Wolvi) or XIII (Tansey); and the spermathecal ducts are narrow, not dilated. Lengths vary from 152–250 mm, and widths from 6–9 mm.

The specimens from Bauple (with transverse pads) have a suggestion of a genital marking on each side of the transverse pad in XVII and the male porophore has a callus-like extension into XVII and XIX. This extension supports identity with the Wolvi material which is illustrated in Fig. 3B.

Identity of the new material listed above with the similarly metandric *D. longmani* is ruled out on the grounds that in *D. longmani* the transverse genital markings are preclitellar and the first dorsal pore is more anterior.

#### *Digaster gwongorellae* Jamieson, 1972

Figs. 1; 9E

*Digaster gwongorellae* Jamieson, 1972, pp. 261–4, figs. 1A–C.

MATERIAL EXAMINED: *Ps* 4, 153°11'E. 28°21'S., Binna Burra, Lamington National Park, in rainforest, B. Jamieson and E. Bradbury, 24 Mar 1971. QM G8332, BM(NH) 1973.10.106.

l > 110 and 75 mm (specimens 1 and 2, posterior amputees) w (midclitellar) = 5 mm, s = ?

Prostomium tanylobous. First dorsal pore 5/6 faint but perforate; larger but inconspicuous from 6/7. Clitellum annular,  $\frac{1}{2}$  XIII– $\frac{1}{3}$  XIX but circumscribed by deep furrows at 13/14 and 18/19 (extent XIV–XVIII in syntypes). Setae in 8 regular longitudinal rows. Setae *a* and *b* absent in XVIII. Male genital field an almost circular though transversely somewhat widened flat topped conspicuous pad in XVIII extending almost to the setal arcs of XVII and XIX and laterally almost to *c* lines; no median porelike marking present on this pad. In both specimens two minute white points are included within the margin of the pad at *a* and *b* on each side. That in *b* is the larger and has been taken (Jamieson, 1972) to be the male pore but the two markings are possibly the follicles of the absent setae *a* and *b* for, as noted in the type-description, the prostate ducts enter the body wall internally in *a* lines. The muscular ducts are straight and converge medianly so that it is possible that the male pores are shortly median of *a* lines (specimen 1). In specimen 2 the genital pad is narrower longitudinally and is depressed medianly so that an impression of a pair of medianly conjoined papillae is produced. Female pore moderately conspicuous, midventral and presetal in XIV. Spermathecal pores 2 inconspicuous pairs, in 7/8 and 8/9 very slightly lateral of *a* lines (in *a* lines in the types).

Last hearts in XII. Gizzards in VI and VII. Calciferous glands absent. Intestine commencing in XVIII but pushing septum 17/18 forwards so as to appear to commence in XVII. Meronephric. Holandric (sperm funnels iridescent in X and XI); gymnorchous; seminal vesicles racemose, in IX and XII. Prostates restricted to but expanding XVIII, rounded tongue shaped with a deep lateral incision but (unlike the type-specimens) not bipartite. Penial setae absent. Metagynous; ovisacs absent. Spermathecae 2 pairs, in VIII and IX; each with elongate-ovoid ampulla, a slightly shorter well demarcated duct and ectally a multiloculate diverticulum as in the types, (specimen 1).

TYPE-LOCALITY: Gwongorella National Park (Ps 5).

REMARKS: The above brief description confirms identity of this material with the type-series, agreeing with the type-description in almost all respects. The greater extent of the clitellum is attributable to the very mature condition of the new material and inclusion of the points (male pores?) at *b* in XVIII on the protuberant genital marking and not, as in the holotype, on each side of it with an encircling rim, is ascribable to greater elevation of the marking. The very slightly more lateral position of the spermathecal pores and the

form of the prostate glands in the new material are very minor differences.

#### *Digaster longmani* Boardman, 1932

*Digaster longmani* Boardman, 1932, pp. 125–7, fig. 1.  
Jamieson, 1963, pp. 101–5, fig. 5.

The following account is abstracted from the type description and that of Jamieson, 1963. Some features of a specimen from Stradbroke Island, Queensland, which is tentatively identified with *D. longmani*, are appended to the account.

l = 520–1025 mm, w (preclitellar) = 20–25 mm, s = 309–382. Body (pigmented?) brown; clitellum dark brown. Prostomium zygalobous, prolobous or proepilobous. First dorsal pore 5/6, or sometimes 6/7. Setae 8 per segment, difficult to discern or only sporadically visible; typically, in the forebody,  $aa:ab:bc:cd = 4:1:3:1.7$ ;  $dd:u > 0.5$ ; means in the Kyogle specimens, in IX,  $cd:ab = 1.6$  (1.3–1.8);  $bc:aa = 0.4$  (0.4–0.5);  $dd:u = 0.7$  (0.7–0.8). Clitellum annular,  $\frac{1}{2}$  XIII,  $\frac{1}{3}$  XIII, XIV to XVIII,  $\frac{1}{4}$  XIX– $\frac{1}{2}$  XIX (= 5–6 segments). Male pores equatorial or just presetal in XVIII, in *ab*, from *a* to *b*. Accessory genital markings if present, a post-setal, unpaired midventral transverse strip extending laterally to  $\frac{1}{2}$  *bc* in each of segments VIII–XII. Female pores presetal in XIV, transversely or diagonally placed. Spermathecal pores 2 pairs, at anterior borders of VIII and IX or 2 or 3 pairs in 6/7 to 8/9, in or just dorsal of *a*.

Last hearts in XII or, typically, XIII. Gizzards in VI and VII; calciferous glands absent (an unpaired, dorsal oesophageal structure reported as a gland in the holotype was probably a fixation artefact). Intestinal origin XVIII. Nephridia meronephridia; septal bands present but no definite tufts observed; caudally with a median (stomate?) megameronephridium on each side. Metandric; gymnorchous; seminal vesicles in XII only. Prostates racemose, tongue-shaped or discoidal, incised but unipartite in XVIII. penial setae absent. Metagynous; ovisacs unknown. Spermatheca 2 or 3 pairs, tubular to tapering sacciform with the ectal portion forming a poorly demarcated duct; diverticulum typically single, elongate-ovoid, obliquely placed near the pore, extending almost across the flattened side of the duct, containing several sperm masses; duct also bearing 1 or 2 conspicuous obliquely placed sacculations at midlength; if 2, on opposite sides and convergent ectally; the pair of sacculations the only diverticula in the Kyogle specimens.

TYPE-LOCALITY: Tamborine Mountain, South Queensland (Pr. 9).

WIDER DISTRIBUTION: near Oaky Creek, Richmond Range State Forest, and near Kyogle, New South Wales.

STRADBROKE ISLAND SPECIMEN

MATERIAL EXAMINED: *Pr* 5, 153°25'E. 27°30'S., Stradbroke Island, in deep sand, V. Pattemore, 13 Aug 1971, BM(NH) 1973.10.107.

Postclitellar amputee with *w* (midclitellar) = 8 mm. Pigmentless in alcohol excepting light brown clitellum. Prostomium probobous but peristomium much grooved. First dorsal pore 5/6. Setae 8 per segment; dorsal couples varying significantly in width and ventral couples slightly irregular, in the forebody; both couples very irregular in width behind the clitellum. Clitellum annular, dorsally XIII–XX. Male pores transverse slits in *a*, porophores not developed. Accessory genital markings very faint transverse pads filling the posterior annulus, and including the setal arc, in IX, X, XI and XII. Female pores not certainly recognisable, possibly unpaired. Spermathecal pores 2 pairs, in 7/8 and 8/9, in *a*.

Last hearts in XII. Gizzards in VI and VII; calciferous glands absent. Intestinal origin(?) Meronephric. *Holandric*; gymnorchous; seminal vesicles in XI and XII. Prostates racemose, tongue-shaped, unipartite. penial setae absent. Metagynous. Spermathecae 2 pairs, duct tapering; ?diverticulum single, small and caplike on the ectal end of the duct.

REMARKS: Typical specimens of *D. longmani* are distinguished from the only other metandric species in the genus *D. brunneus*, by location of the first dorsal pore in 5/6 or 6/7 (not 9/10–11/12), location of transverse accessory genital markings segmentally in the region of VIII–XII (not intersegmentally in 12/13–16/17) and in possessing an elongate diverticulum sessile over its length or a pair on each side of the duct (not rounded and multiloculate or small and double). Conspecificity of the material from the environs of Kyogle, in New South Wales, with *D. longmani* is not entirely certain as it lacks accessory genital markings and has spermathecal diverticula restricted to the pair of convergent sacculations reported, in addition to a diverticulum, by Boardman but erection of a separate species for its reception is not warranted on present evidence. The identity of the single Stradbroke Island specimen with *D. longmani* is based primarily on the large body size and presence of segmental preclitellar bands which are so faint that positive recognition of them as accessory genital markings must await discovery of further material. The holandric gonads are otherwise un-

known in *D. longmani* though known in *D. bradburyi bumyaensis*, a subspecies of large worms of closely similar morphology. The Stradbroke Island specimen can be excluded from *D. bradburyi*, however, because the latter has its first dorsal pore in 9/10, bipartite prostate glands and dilated spermathecal ducts. The *brunneus-longmani* complex and its relationships with *D. lumbricoides kondalilla* requires further elucidation.

**Digaster lumbricoides** Perrier, 1872

*Digaster lumbricoides* Perrier, 1872, pp. 94–96, pl. 1, fig. 24, pl. 4, figs. 64, 65. Fletcher, 1887, pp. 559–60; 1889, pp. 1531–2. Beddard, 1895, p. 485. Michaelsen, 1900, p. 197. Jamieson, 1971b, pp. 1303–6, figs. 1, 1–K.

The following account is based on the redescription of the type-specimens by Jamieson, 1971b and on new material, comprising a new subspecies, from Kondalilla.

*l* = 82 mm, *w* (midclitellar) = 3.3–3.5 mm, *s* = 158. Form moderately stout, circular in cross section throughout; pigmentless buff in alcohol. Prostomium probobous. First dorsal pore 4/5 but may not be perforate until 5/6 or 6/7. Setae small, in 8 regular longitudinal rows, commencing in II; setae *a* and *b* present or absent on the segment bearing the male pores; *aa:ab:bc:cd:dd* in XII averaging 2.3–3.6:1.3–6.4:2.1–8.3:12.6–13.3; *dd:u* = 0.40–0.48; *c* and *d* not especially dorsal posteriorly. Clitellum annular, typically XII– $\frac{1}{2}$ XVII. Male pores on XVII or XVIII in *ab* or *b* in an approximately rectangular tumid field which extends to the equators of the adjacent anterior and posterior segment, an oval glandular genital marking located near each corner of the field, posteriorly in XVI and anteriorly in XVIII (where male pores are in XVII) or at intersegments 17/18 and 18/19 (where male pores are in XVIII). Female pores shortly anteromedian of setae *a* of XIII or XIV. Spermathecal pores 2 pairs, in 6/7 and 7/8, or 7/8 and 8/9, in *a* or *ab*.

Dorsal blood vessel single, continuous onto the pharynx. Last hearts in XI or XII; the last 3 pairs latero-oesophageal, each receiving a connective from the dorsal vessel and from the roof of the oesophagus, no discrete supra-oesophageal vessel being recognisable. Subneural vessel absent. Gizzards in V and VI or VI and VII, intervening unmodified oesophagus short or inappreciable; calciferous glands absent though the oesophagus is dilated and vascularized in some of the segments XIII–XVI; intestinal origin  $\frac{1}{2}$  XVI or XVIII; typhlosole, muscular thickening and caeca absent. Nephridia meronephridia, enteronephry not obser-



ved; caudally with a stomate megameronephridium on each side median to astomate micromeronephridia. Holandric; gymnorchous; seminal vesicles racemose in X and XI or XI and XII, accompanied below the oesophagus in XI or in XI and XII by an unpaired seminal vesicle. Prostates racemose unipartite or bipartite. Penial setae absent. Ovaries in XIII (or XII?); ovisacs unknown. Spermathecae 2 uniform pairs; duct cylindrical with small subspherical ectal diverticulum or duct pyriform, ectally widening, with a small rounded more or less bifid diverticulum on the ectal dilatation; length of a spermatheca 2.2–3.9 mm, ratio of length spermatheca: length duct = 1.6–2.0; ratio length spermatheca: length diverticulum = 5.3–7.9.

TYPE-LOCALITY: Port Macquarie, New South Wales.

WIDER DISTRIBUTION: Kondalilla National Park, Queensland (Oq 8).

***Digaster lumbricoides lumbricoides* Perrier, 1872**

Figs. 1; 9F

For detailed account see Jamieson, 1971b. Characters as for specific description, above, with: l = 82 mm, w (midclitellar) = 3.3 mm, s = 158. In XII, *aa:ab:bc:cd:dd* averaging 2.3:1.4:2.1:8:12.6; *dd:u* = 0.40–0.48. Male pores in XVII, in *ab*; paired genital markings posteriorly in XVI and anteriorly in XVIII, in and lateral of *b* lines. Spermathecal pores in 6/7 and 7/8 in *ab*.

Septa 6/7 or 7/8 the thickest, strongly thickened. Last hearts in XI. Gizzards in V and VI; intestinal origin  $\frac{1}{2}$  XVI. Seminal vesicles in X and XI, accompanied below the oesophagus in XI by an unpaired seminal vesicle. Prostate glands unipartite. Spermathecae each with a subspherical ampulla and a wide cylindrical duct; diverticulum ectal on the duct; length of a spermatheca 2.2 mm, ratio of length:length duct = 1.6; ratio of length:length diverticulum = 5.3.

TYPE-LOCALITY: Port Macquarie, New South Wales.

***Digaster lumbricoides kondalilla* subsp. nov.**

Figs. 1; 5A, B; 10H, I; 11D

MATERIAL EXAMINED: Oq 8, 150°50'E, 26°40'S., Kondalilla National Park, in black soil under boulder on creek bank, in rainforest, T. Walker, 2 Jun 1972, Holotype, QM G7396.

l = 60+ mm (posterior amputee at 71st. segment), w (XV) = 3.5 mm. Peristomium with several dorsal longitudinal grooves though not

grooved ventrally. First dorsal pore 4/5. Setae small but distinctly visible; setae *a* and *b* persisting in XVIII in the vicinity of the male pores. Clitellum not developed. Male pores transverse slits in XVIII shortly anterior to setae *b*, each on a low oval tumescence which bears setae *a* and *b*; the male porophores preceded at 17/18 and succeeded at 18/19 by a pair of oval glandular areas, in *ab*, each of the posterior areas accompanied by and partly continuous with a similar glandular marking lateral of *b* lines in the same intersegment. The male porophores and these genital markings lying in an approximately tumid quadrangular field which extends to the setal arcs of segments XVII and XIX and laterally almost to *c* lines. Female pores shortly anteromedian of setae *a* of XIV on a common transverse presetal protrusion. Spermathecal pores 2 pairs of partially concealed transverse slits at the anterior limit of small knoblike swellings, in 7/8 and 8/9, centred in *a* lines.

Septa 8/9–11/12, the thickest, strongly thickened. Last hearts in XII; those in XII (and X–XI?) latero-oesophageal. Pharynx ending in IV; in V the oesophagus is dilated and gizzard-like in appearance though not thickwalled and little more than half the diameter of the gizzards. Gizzards large and firm, in VI and VII; globose though with an anterior rim which is weakly developed in the posterior but is well developed in the anterior gizzard; the gizzards filling their segments; and not separated by an appreciable length of unmodified oesophagus though the oesophagus is narrowly constricted between them. Oesophagus longitudinally constricted and lacking special modification in IX–XIII; in each of XIV, XV and XVI dilated and vascularized, with a pair of circumferential vessels which join the dorsal vessel, and internally with many high clavate villi; slender in XVII and XVIII. Intestinal origin XIX. Nephridia in IV–VI aggregated into loose tufts; no enteronephry demonstrated but certain elucidation of the excretory system not feasible as preservation unsatisfactory; in the anterior intestinal region with seven astomate exonephric parietal micromeronephridia on each side from setal line *a* to above *d* and an aggregation of similar but smaller nephridia median to *a*; these median aggregations not present further posteriorly. No stomate nephridia detectable anterior to the amputation. Sperm funnels iridescent in X and XI; small paired seminal vesicles racemose in XI and XII, accompanied below the oesophagus by a large unpaired racemose seminal vesicle in each segment. Prostate glands large but restricted to XVIII, racemose and bipartite, the muscular duct branching entally to the two major lobes, then the branches in turn showing limited

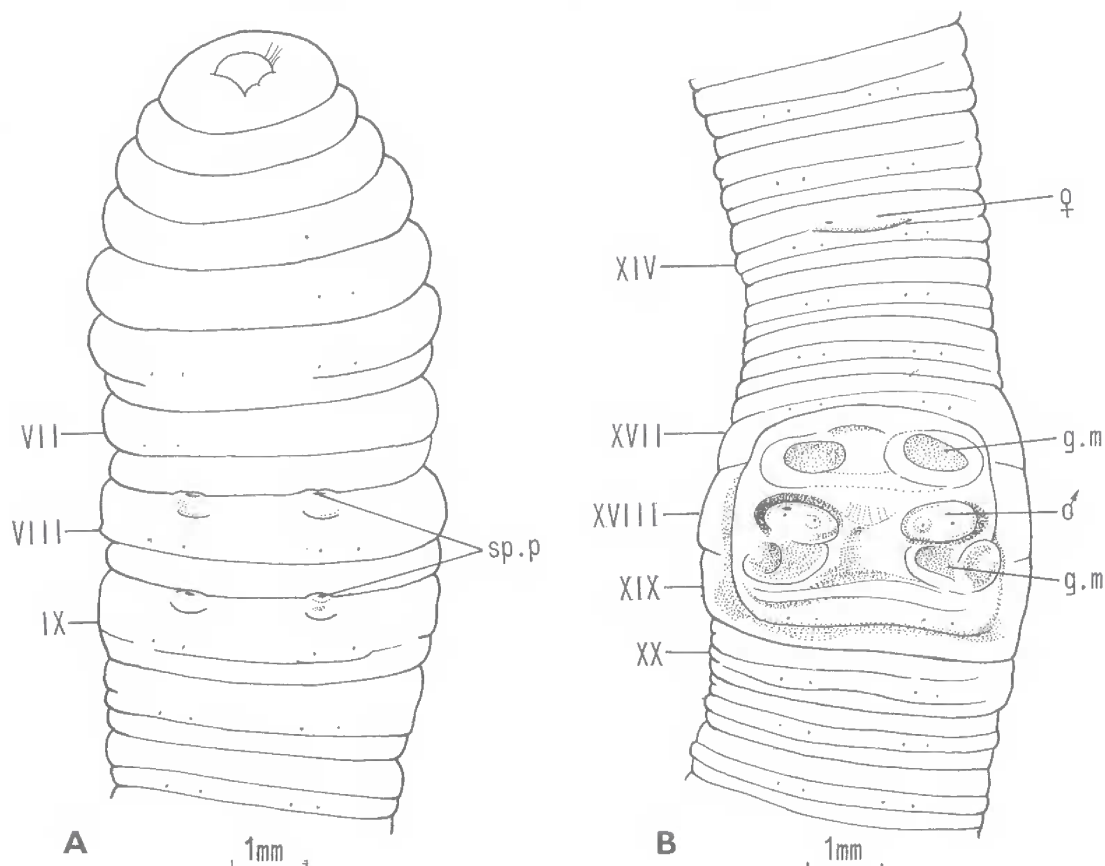


FIG. 5: *Digaster lumbricoides kondalilla* subsp. nov. A, Spermathecal field; B, Male genital field of holotype. For key to abbreviations, see Fig. 9.

branching; the branching visible when the prostatic lobes are separated. Penial setae absent, though *a* and *b* follicles are externally visible. Ovaries (diffuse webs with small oocytes) and funnels in XIII. Spermathecae each with an ovoid-sacciform ampulla and an elongate pearshaped, ectally widening duct of similar length which bears a small rounded sessile more or less distinctly bifid (iridescent) diverticulum dorsally on the ectal dilatation; length of right spermatheca of VIII = 3.9 mm; ratio of length spermatheca: length duct = 2.0; ratio of length spermatheca: length diverticulum = 7.9.

**REMARKS:** *Digaster lumbricoides*, the type-species of the genus was previously known only from material collected at Port Macquarie in 1846 (Jamieson, 1971b). Although erection of a new subspecies on a single specimen is undesirable, it is preferable to total identification of this distinctive specimen with *D. lumbricoides* as represented by the earlier material. Some differences from the nominate subspecies are: location of male pores on XVIII; origin of the intestine in XIX (not  $\frac{1}{2}$  XVI);

the more strongly bipartite condition of the prostates and (significantly?) the ectal widening of the spermathecal ducts; location of the male pores in *b* and of spermathecal pores in *a* lines, rather than *ab*, and the intersegmental, not postsetal location of the genital markings with lateral duplication of the posterior markings. These are minor differences of doubtful importance.

Dilatation of the spermathecal ducts and the bipartite form of the prostate glands are shared with *D. bradburyi* with which affinities are close. On the other hand, the quadrangular raised genital field with genital markings on the corners, post-testicular paired and median seminal vesicles and anterior dorsal pores strongly indicate conspecificity with *D. lumbricoides*. It is possible that *D. bradburyi* consists of populations of the earlier named *D. lumbricoides* but elucidation of the *lumbricoides-bradburyi* complex and of relationships of these with *D. brunneus* and *D. longmani* requires further studies of morphology and reproductive isolation of the constituent populations.

***Digaster minima* sp. nov.**

Figs. 6A; 10J; Table 3

MATERIAL EXAMINED: *Or* 7, 152°47'E. 27°23'S., Mt. Nebo Road, Mt. Nebo, Queensland, in loamy soil in gully in eucalypt area, E. Bradbury, 12 Jun 1970, Holotype (H) QM G7397, Paratypes (P) 2, 3, QM G7398-9. P1, BM(NH) 1973.10.108. 1 mile from Mt. Nebo on road, E. Bradbury, 10 Aug 1970, P4, BM(NH) 1973.10.109.

l = ? (H, posterior amputee), 28 (P1), 41 (P2) mm. w (midclitellar) = 1.7 mm, s = 122 (P2). Form slender, circular in cross section; pigmentless in alcohol. Prostomium proepilobous, slightly (P1, 2) to  $\frac{2}{3}$  peristomium (H), peristomium with or without slight dorsal furrows. First dorsal pore 9/10 (H, P1, 2) with possibly some imperforate preceding this. Setae visible with difficulty anteriorly where they lie in 8 longitudinal rows, commencing on II; shortly behind the clitellum they are recognisable only with the greatest difficulty until in the last approximately 30 caudal segments where the dorsal pair on each side is enlarged and is shifted dorsally so that the 4 setae *cd* are approximately equidistant from each other; *c* and *d* are also displaced dorsally in anterior segments though not so markedly; setae *a* and *b* absent in XVIII. Clitellum annular, XIV- $\frac{2}{3}$ XVIII; (H, P2) setae visible; dorsal pores obliterated; intersegmental pores represented only ventrally. Male pores in longitudinal crescentic grooves equatorially in *ab* of XVIII on broad, low, medianly widely conjoined (H) or just contiguous porophores (P1, 2) which almost reach the setal arcs of XVII and XIX or (P1, 2) are less extensive. Accessory genital markings midventral unpaired circular segmental papillae with porelike centres in each of segments XII and XIII and XX-XXIV (H). A paired marking sometimes present in the setal arc and bearing setae *ab* on its posterior aspect in X (P1, unilateral left only; P2, 4 bilateral). Median marking in XII (P1, 3, 4), XIII (P1-4); XV (P2, 4); XVI (P4); XIX (P2, 3); XX and XXI (P1-4) and XXII (P2, 3). Female pores a pair shortly anteromedian of setae *a* of XIV. Spermathecal pores 2 pairs, near the anterior margins of VIII and IX in *ab*, nearer *a* (H) or in *a* lines, on small rounded papillae.

Septa 6/7 and 7/8 the strongest, those to 10/11 moderately strong. Dorsal blood vessel single, continuous onto the pharynx. Last hearts in XII. Pharynx ending in IV; oesophagus wide and thinwalled in V; gizzards well developed, globose, not separated by unmodified oesophagus but a narrow anterior part of the posterior gizzard relatively unthickened. Calciferous glands absent. Origin of intestine indefinite, apparently  $\frac{1}{2}$  XVII in P1; caeca and muscular thickening absent; definite

typhlosole absent but a very low dorsal ridge present from approximately XXIV posteriorly. Meronephric: no tufts present; nephridia few micromeronephridia; in the anterior intestinal region 3 on each side in longitudinal rows, one row in *ab*, the second at mid *bc*, the third in *cd*. Metandric; sperm funnels strongly iridescent in XI; gymnorchous; seminal vesicles racemose in XII (H, P1) a spermatheca-like iridescent sac (accessory seminal vesicle?) extends below the gut from septum 12/13 into XIII (H only). Metagynous; ovaries flattened laminae with numerous oocytes in XIII; ovisacs absent. Prostates racemose, squarish bifid lobes, occupying about four segments; vas deferens joining the muscular anteromedianly directed duct at its junction with the gland. Penial setae absent. Spermathecae 2 uniform pairs, each with ovoid ampulla and well demarcated fairly slender duct; a single (inseminated) subspherical diverticulum joining the duct by a narrow very short stalk at midlength; the diverticulum externally simple but with several internal sperm masses; length of right spermatheca of IX (H) = 1.7 mm; ratio of length spermatheca: length duct = 1.8; ratio of length spermatheca: length diverticulum = 5.6.

REMARKS: Only *D. pseudoperichaeta* shares with *D. minima* the extreme dorsal displacement of the dorsal setal couples in caudal segments. Both have the metandric condition of the male gonads seen elsewhere in the genus only in *D. brunneus* and *D. longmani*. It appears likely that the two species are more closely related one to the other than to other species. They are clearly interdistinguishable by the male genital fields.

*D. minima* is the smallest known species of *Digaster*.

***Digaster nothofagi* sp. nov.**

Figs. 1; 6B; 10K; 11F; Table 3

MATERIAL EXAMINED: *Ps* 5, 153°17'E. 28°13'S., Springbrook, Best of All Lookout, under *Nothofagus* (Antarctic beeches), B. Jamieson and E. Bradbury, 22 Apr 1971, Holotype, QM G7400.

l = 81 mm, w (midclitellar) = 5.2 mm, s = 196. Form moderately stout, circular in cross section; pigmentless buff in alcohol. Prostomium epilobous  $\frac{2}{3}$  open, dorsally bisected by a longitudinal groove. Peristomium with numerous faint longitudinal grooves but not bisected. First dorsal pore 4/5. Setae small but visible, in 8 regular longitudinal rows throughout, commencing on II. Setae *a* and *b* absent.

Nephropores not externally recognisable. Clitellum hardly appreciable externally but seen from the

dorsal incision to extend from XIV–XVII with some very weak development in the adjacent halves of XIII and XVIII; apparently annular. Male pores minute, in *ab* of XVIII, on small papillae. Accessory genital markings: an unpaired midventral papilla posteriorly in IX, X and XVII and in 18/19, 19/20 and 20/21, all well within *aa* excepting that in IX which extends laterally into *ab*; paired papillae postsetal in *ab* in XVII and lateral to *b* in XVIII; segments VII and VIII with an indistinct tumid

band postsetally connecting the spermathecal pores. Female pore unpaired, presetal in XIV. Spermathecal pores 2 pairs in 7/8 and 8/9, immediately lateral to *a* lines on minute papillae.

Septa 6/7–10/11 strongly thickened. Dorsal blood vessel single, continuous onto the pharynx. Last hearts in XII; those in X–XII latero-oesophageal, taking their main origin from the supra-oesophageal vessel but with very slender connectives from the dorsal vessel. Supra-

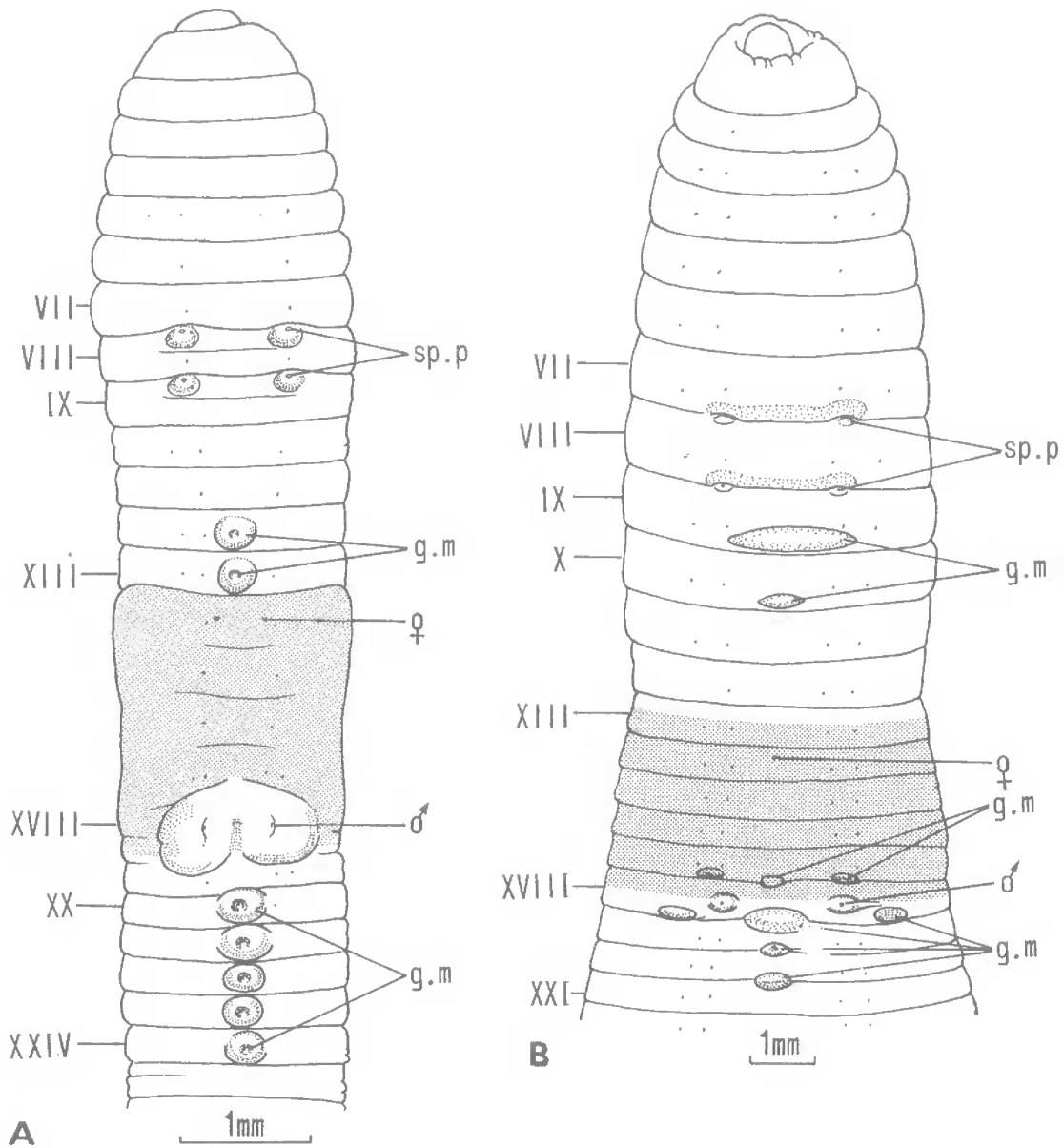


FIG. 6: A, *Digaster minima* sp. nov. Genital field of holotype. B, *D. nothofagi* sp. nov. Genital field of holotype. For key to abbreviations, see Fig. 9.

oesophageal ill-defined, limits indeterminable. Subneural vessel absent. Oesophagus in V slightly dilated, thin-walled, hidden by septal glands. Two strong subspherical gizzards with slightly developed anterior rims, in VI and VII, the oesophagus between them strongly constricted but very short. Oesophagus almost suppressed, by backward extension of the gizzards, in VIII and IX; short and simple in X–XIII; swollen and vascularized in XIV–XVII, where a paired circumferential vessel joins the dorsal vessel, with low, sinuous internal rugae especially dilated in XV and XVI; oesophagus narrow in XVIII. Intestinal origin XIX; typhlosole, caeca and muscular thickening absent. Nephridia meronephridia: masses of spiral loops in IV, V, VI and VII, on the posterior septa of these segments, those in V–VII apparently but not certainly exonephric, those in IV with connections to the pharynx which may be ducts. Sparse lateral parietal bands of exonephric micromeronephridia in II and III and in VIII posteriorly; in the anterior intestinal region 8 or 9 on each side and a small group median to these; caudally with the median-most nephridium enlarged as an exonephric megameronephridium with preseptal funnel. Holandric, gymnorchous (sperm funnels iridescent in X and XI); seminal vesicles racemose, in IX and XII. Prostates racemose, tongue-shaped, each entally divisible into a dorsal and a ventral lobe; vas deferens joining the straight medianly directed muscular duct near its junction with the gland. Metagynous (ovaries not seen; oviducal funnels in XIII); ovisacs absent. Spermathecae 2 uniform pairs; ampulla elongate ovoid; duct cylindrical bearing an iridescent multiloculate diverticulum near its ectal extremity; length of right spermatheca of IX = 2.6 mm; ratio of length spermatheca: length duct = 2.6; ratio of length spermatheca: length diverticulum = 4.1.

REMARKS: *D. nothofagi*, from a spur on the escarpment of the Macpherson Range, closely resembles *D. binnaburra* from neighbouring parts of the same range. The two taxa are clearly distinguished by the genital fields which are sufficiently different to suggest reproductive isolation, one from the other.

***Digaster pseudoperichaeta* sp. nov.**

Figs. 1; 7; 10L; 11G; Table 3

MATERIAL EXAMINED: *Or* 4, 152°59'E. 27°16'S., Y.M.C.A. Camp Warrawee, near Petrie, in sandy loam under *Catospermum* in riverine vine forest, B. Jamieson, 17 Feb 1969. Holotype (H) QM G7401. Paratypes (P) 2, 3 QM G7402–3, P1, BM(NH) 1973.10.110.

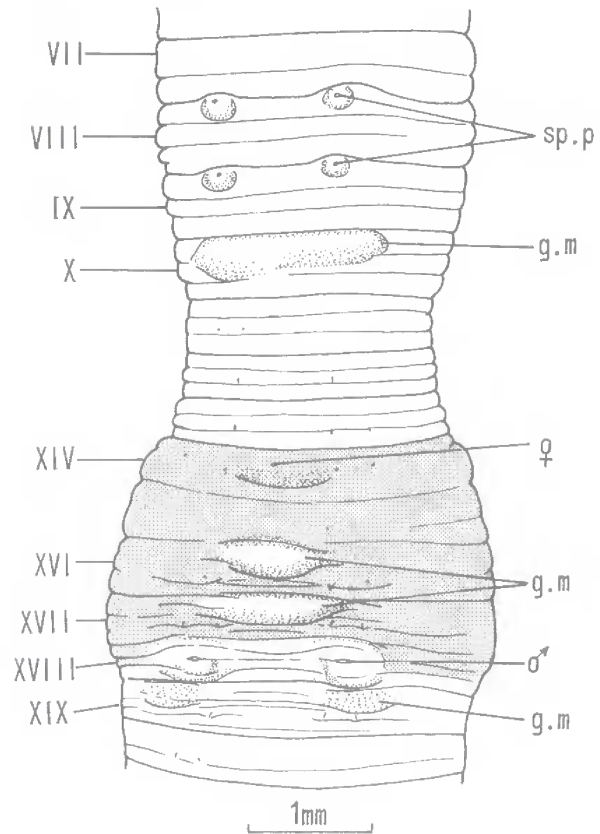


FIG. 7: *Digaster pseudoperichaeta* sp. nov. Genital field of holotype. For key to abbreviations, see Fig. 9.

l = 36 (P1)–45 mm(H), w (midclitellar) = 2.7 (P1)–3.3(H) mm, s = ? (not countable owing to maceration). Form circular in cross section, moderately slender. Pigmentless in alcohol. Prostomium epilobous  $\frac{1}{2}$ , open, faintly canaliculate. Dorsal pores minute, commencement indeterminable. Setae commencing on II, in 8 regular longitudinal rows throughout but the dorsal couples (*cd*) caudally moving to a dorsal situation so that by approximately 15 (P1) or 25(H) segments from the posterior end the four setae of the two dorsal couples are equispaced, and are large and readily seen, whereas the more anterior setae, and all ventral couples, are minute and inconspicuous. Setae *a* and *b* absent in XVIII. Clitellum annular, XIV–XVII well developed and protuberant; setae visible, dorsal pores occluded; intersegmental furrows almost obscured. Male pores a pair of transverse slits in *ab* on low whitish porophores which fill the segment longitudinally. Accessory genital markings: a midventral transverse, strongly protuberant pad occupying the anterior two thirds of X and extending laterally beyond *b*; a further

midventral pad anterior to but overlapping the setal arc of XVI and XVII, anteriorly impinging very slightly on the preceding segment, and extending laterally to *a* and *ab* respectively; and a pair of white tumescences on XIX anterior to the ventral setal couples which latter are themselves on a white glandular transverse ridge on each side (H, P1-3). Spermathecal pores 2 pairs, near the anterior borders of VIII and IX, in *ab* on circular prominences:

Septa 6/7 and 7/8 the thickest, strongly thickened. Dorsal blood vessel single, continuous onto the pharynx. Last hearts in XII (vascular system macerated).

Oesophagus wide and very thin walled in V; two relatively very large, strong, globular gizzards, in VI and VII, separated by a deep constriction where the oesophagus is unthickened though of negligible length. Oesophagus suppressed by backward extension of the gizzards in VIII; moniliform and vascularized but lacking calciferous glands, in IX-XII; narrowly tubular and sinuous in XIII-XVII; intestinal origin XVIII; typhlosole, caeca and muscular thickening absent. Meronephric, with a few rows of fairly large meronephridia on each side in the oesophageal and intestinal regions of which the medianmost nephridium in caudal segments has a preseptal funnel but is not appreciably enlarged; nephridia in pharyngeal and buccal segments more numerous but no tufts detectable. Metandric (sperm funnels, iridescent, XI); gymnorchous; seminal vesicles racemose in XII only. Metagynous (ovaries with several chains of large oocytes); ovisacs absent. Prostates racemose, tongue-shaped but entally bifid; restricted to XVIII; vas deferens joining the junction of the gland with the short muscular duct. Penial setae absent. Spermathecae 2 uniform pairs, ampulla very slender and elongate, almost tubular, lacking a distinct duct though the widened ectal fourth may be considered one; diverticulum (inseminated) consisting of several distinct loculi, sessile near its ectal limit; length of right spermatheca of IX (H) = 2.27 mm; ratio of length spermatheca: length diverticulum = 4:1.

REMARKS: *D. pseudoperichaeta* is closest to *D. minima* from which it is distinguished on p. 285.

***Digaster sexpunctata* sp. nov.**

Figs. 1; 8; 10M; 11H; Table 3.

MATERIAL EXAMINED: *Ps* 6, 153°27'E. 28°05'S., 2 miles along Austinville Road, near Burleigh, South Queensland, E. Bradbury, 10 Apr 1970, Holotype (H) QM G7404, Paratype (P) BM(NH) 1973.10.111.

l = 55 mm, w (midclitellar) = 5 mm, s = 142 (H; paratype is posterior amputee). Form circular in cross section throughout, moderately stout. Pigmentless. Prostomium indistinctly tanylobous, faintly canaliculate, but almost indistinguishable from other longitudinal furrowing of the peristomium. First dorsal pore 4/5 (H) or 5/6 (P). Setae in 8 regular longitudinal rows, commencing on II; setae *a* and *b* absent in XVIII. Nephropores not externally visible. Clitellum (developed in H only, though not fully) annular, XIV- $\frac{2}{3}$ XVIII; intersegmental furrows and dorsal pores present though weaker, setae present. Male pores in

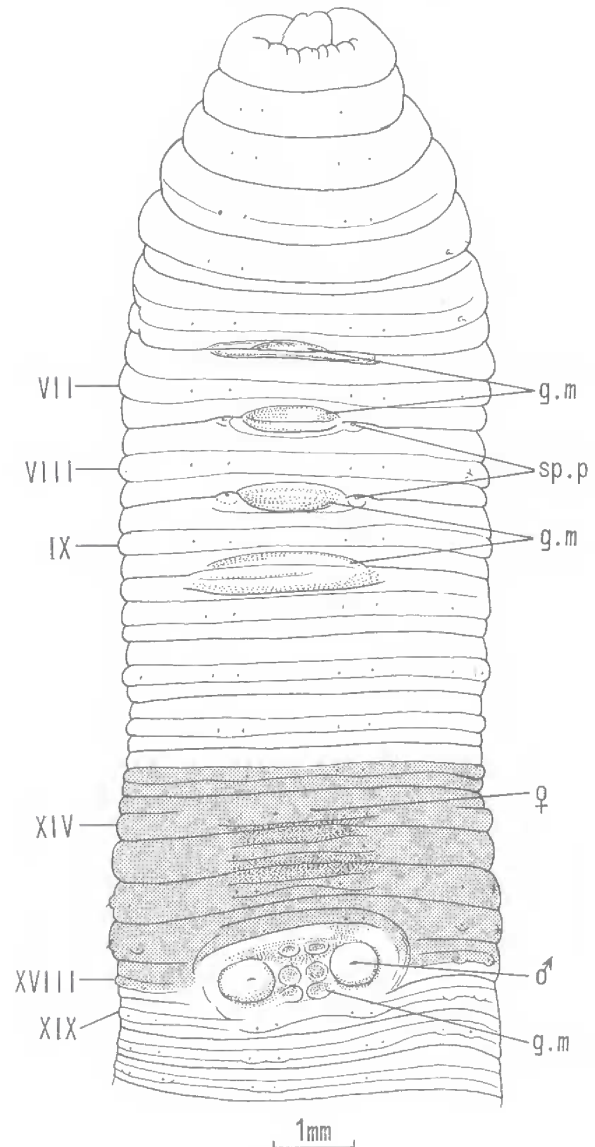


FIG. 8: *Digaster sexpunctata* sp. nov. Genital field of holotype. For key to abbreviations, see Fig. 9.

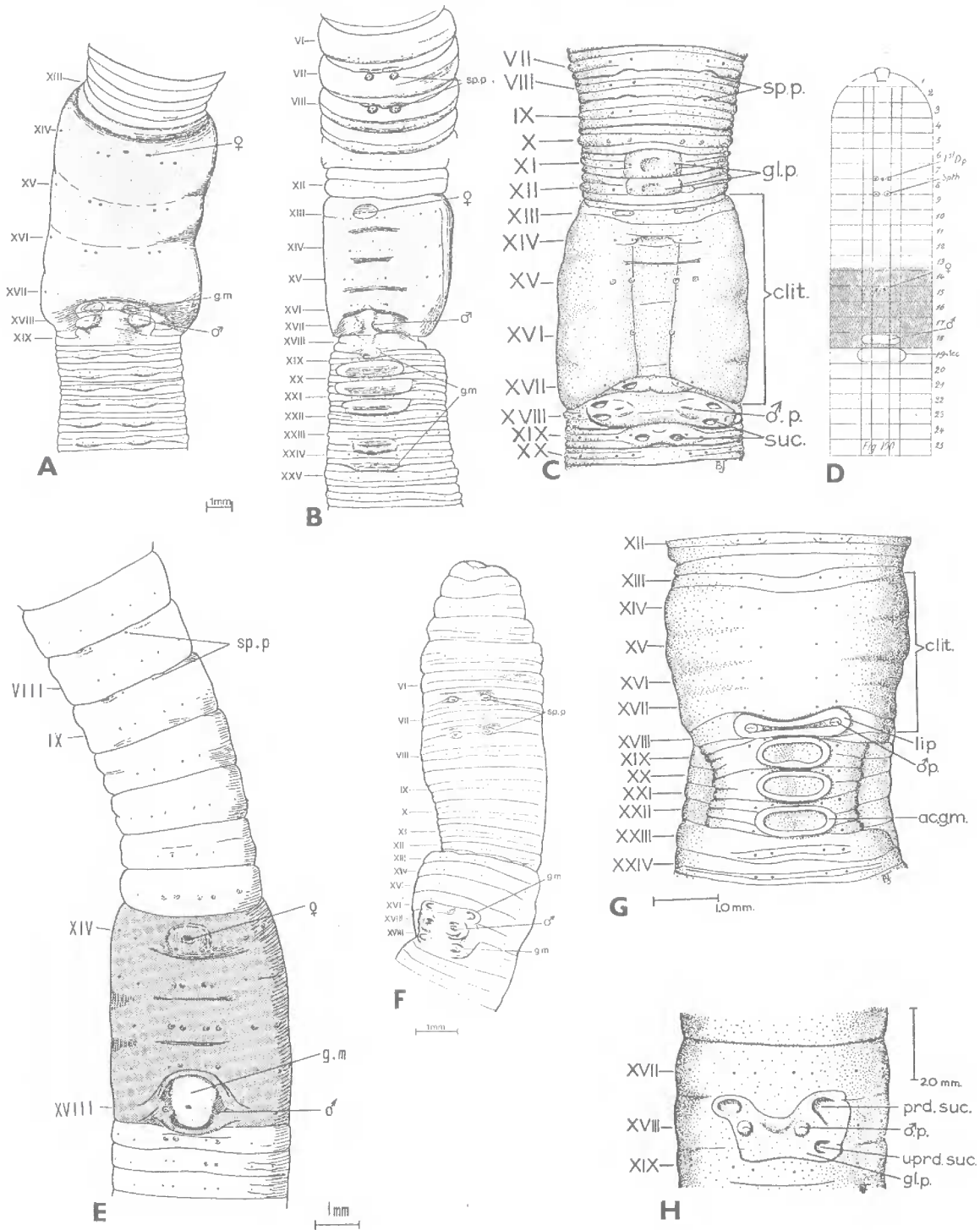


FIG. 9: Genital fields of: A, *Digaster bradburyi bradburyi*; B, *D. anomala*; C, *D. armifera*; D, *D. minor*; E, *D. gwongorellae*; F, *D. lumbricoides lumbricoides*; G, *D. gayndahensis*; H, *D. lamingtonensis*. (A and B from Jamieson, 1970; C, G and H from Jamieson, 1963; D from Spencer, 1900; E from Jamieson, 1972; F from Jamieson, 1971).  
 ac.g.m, accessory genital marking; clit, clitellum; ♀, female pore; g.m, accessory genital marking; gl. p, glandular pad; ♂, male pore; prd. suc, paired suckerlike genital marking; sp.p, spermathecal pore; suc, suckerlike genital marking; uprd. suc, unpaired suckerlike genital marking.

XVIII in *ab* near *b* on hemispheroidal papillae surrounded by a common prominent rim which extends at least to the setal arcs of XVII and XIX and laterally to mid *bc*; the male porophores separated by a pair of very small disc-like equatorial genital markings which are preceded and succeeded by a similar pair of markings which are intersegmental in 17/18 and 18/19 (H, P); additional genital markings on a transverse pad in each of intersegments 6/7, 7/8, 8/9 (H, P) and 9/10 (H); those in 6/7 and 9/10 filling *bb* (H) or that in

6/7 median to *a* (P); those in 7/8 and 8/9 filling the interval between the spermathecal pores. Female pores anteromedian to setae *a* of XIV, about  $\frac{1}{4}aa$  apart, on a common elliptical tumescence. Spermathecal pores 2 pairs, at the anterior borders of VIII and IX, on small papillae (H, P).

Septa 10/11 and 11/12 the thickest, strongly thickened. Dorsal blood vessel single, continuous onto the pharynx. Last hearts in XII; those in X–XII latero-oesophageal, each receiving a connective from the dorsal vessel and the weakly

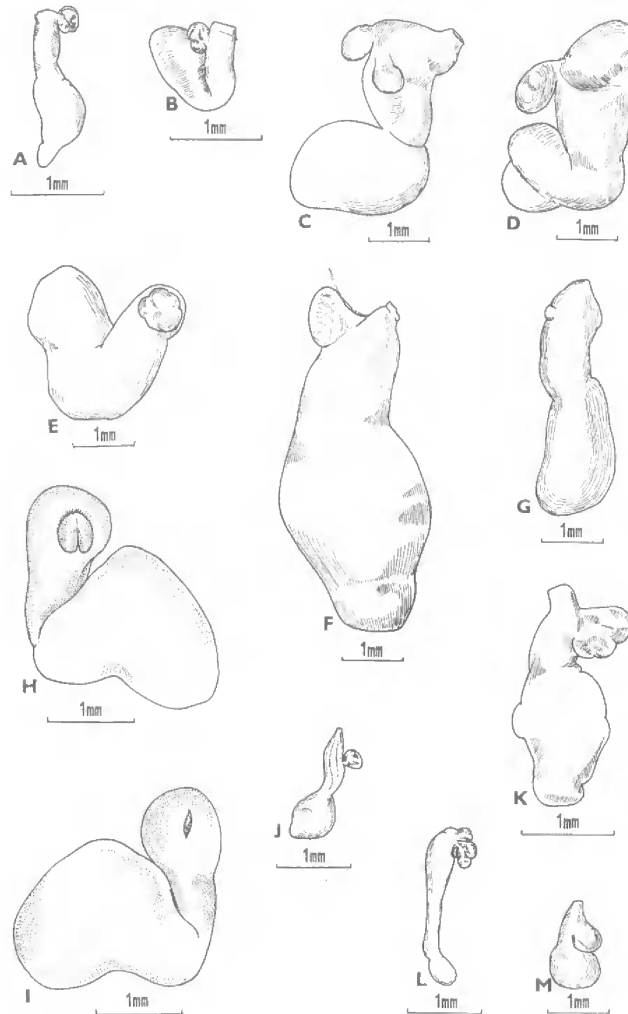


FIG. 10: Spermathecae in *Digaster*: A, B, *D. binnaburra* sp. nov., holotype, A, right VIII, B, right IX; C, D, *D. bradburyi bunyaensis* subsp. nov., holotype, C, left VIII, D, right IX; E–G, *D. brumeus* Spencer, 1900, right IX, E, BM(NH) 1973.10.98; F, BM(NH) 1973.10.100, G, Wolvi specimen, BM(NH) 1973.10.105; H, I, *D. lumbricoides kondalilla* subsp. nov., holotype, right VIII, H, dorsal, I, ventral; J, *D. minima* sp. nov., holotype, right IX; K, *D. nothofagi* sp. nov., holotype, right IX; L, *D. pseudoperichaeta* sp. nov., holotype, right IX; M, *D. sexpunctata* sp. nov., holotype, right IX.



developed supra-oesophageal vessel. Subneural vessel absent. Pharynx ending in III; oesophagus in IV and V segmentally dilated and very thin walled. Two strong subspherical gizzards, in VI and VII, separated by a short region of unmodified oesophagus. Oesophagus almost suppressed in VIII by backward extension of the gizzards; moniliform and vascular in IX–XIII; in XIV, XV and XVI with longitudinally striated lateral outpouching but not cut off from the oesophageal lumen and with only low internal rugae, not forming definite calciferous glands. Oesophagus narrow in XVII; intestinal origin XVIII; muscular thickening, caeca and typhlosole absent. Nephridia meronephridia (H, P); large tufts in IV, V and VI sending ducts to a common composite duct on each side which joins the anterior aspect of the buccal cavity dorso-

laterally; II, III and VII posteriorly, with parietal micromeronephridia which form dense lateral bands in VII; approximately 10 on each side by the anterior intestinal region. Posteriorly with moderately enlarged exonephric megameronephridium, with preseptal funnel, median to astomate, exonephric micromeronephridia (H). Holandric (iridescent sperm funnels in X and XI); gymnorchous; large racemose seminal vesicles in IX and XII. Metagynous, ovaries with numerous united strings of large oocytes (H, P); small ovisacs (?) in XIV in H, not observable in P. Prostates racemose, tongue-shaped, restricted to but enlarging XVIII; vas deferens joining the straight medianly directed duct where this joins the gland. Penial setae absent. Spermathecae with widely ovoid to subspherical ampulla; the mod-

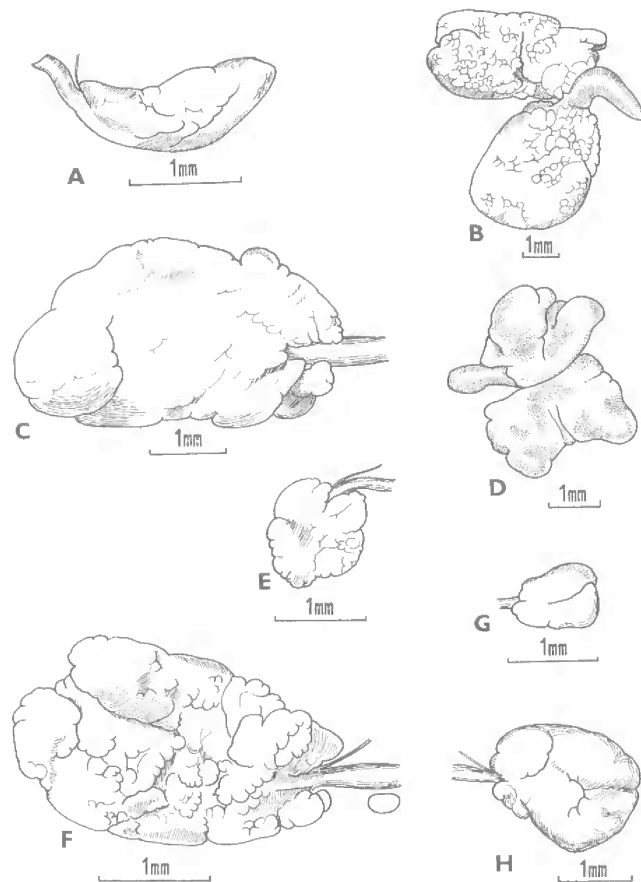


FIG. 11: Prostates in *Digaster* (L = left; R = right). A, *D. binnaburra* sp. nov., holotype, R; B, *D. radburyi bunyaensis* subsp. nov., holotype, L; C, *D. brunneus* Spencer, 1900, BM(NH) 1973.10.98; L; D, *D. lumbricoides kondalilla* subsp. nov., holotype, R; E, *D. minima* sp. nov., holotype, L; F, *D. nothofagi* sp. nov., holotype, L; G, *D. pseudoperichaeta* sp. nov., holotype, R; H, *D. sexpunctata* sp. nov., holotype, R.

erately narrow, well demarcated duct joined at or shortly ectal of midlength by a subspherical internally multiloculate (inseminated) broadly sessile diverticulum; the ampulla packed with nematodes (H, P); length of right spermatheca of IX (H) = 1.5 mm; ratio of length: length duct = 1.8 ratio of length: length diverticulum = 3.0.

REMARKS: The spermathecal and male genital fields of this species are highly distinctive.

#### ACKNOWLEDGMENTS

I am deeply indebted to Mr R. W. Sims, the authorities of the British Museum (Natural History), and Professor R. P. Dales of Bedford College, for providing facilities for this study. Mr E. Bradbury and Mr T. Walker are thanked for their assiduous collecting and Mr Walker for aid in mapping. The work was made possible by Royal Society Nuffield and Australian Research Grants Committee grants.

#### LITERATURE CITED

- BAGE, F., 1910. Contributions to our knowledge of Australian Earthworms. The Nephridia. *Proc. R. Soc. Vict.* (n.s.) **22** (2): 224-43.
- BEDDARD, F. E., 1895. A monograph of the Order Oligochaeta. (Clarendon Press: Oxford).
- BOARDMAN, W., 1932. Some earthworms from Queensland. *Mem. Qd Mus.* **10** (2): 125-30.
- FLETCHER, J. J., 1887. Notes on Australian earthworms. Part I. *Proc. Linn. Soc. N.S.W.* **1**: 523-74.
1888. Notes on Australian earthworms. Part III. *Proc. Linn. Soc. N.S.W.* (2) **2**: 375-402.
1889. Notes on Australian earthworms. Part V. *Proc. Linn. Soc. N.S.W.* (2) **3**: 1521-58.
- JAMIESON, B. G. M., 1963. A revision of the earthworm genus *Digaster* (Megascolecidae, Oligochaeta). *Rec. Aust. Mus.* **26** (2): 83-111.
1970. Two new sympatric species of the earthworm genus *Digaster* (Megascolecidae: Oligochaeta) from Queensland. *Proc. R. Soc. Qd.* **82** (3): 35-46.
- 1971a. A review of the megascolecoid earthworm genera (Oligochaeta) of Australia. Part III—The subfamily Megascolecinae. *Mem. Qd Mus.* **16** (1): 69-102.
- 1971b. Descriptions of the type-species of the earthworm genera *Plutella* and *Digaster* (Megascolecidae: Oligochaeta). *Bull. Mus. natn. Hist. nat., Paris* (2) **42** (6): 1300-10.
1972. A new species of *Digaster* (Megascolecidae: Oligochaeta) from Queensland. *Mem. Qd Mus.* **16** (2): 261-4.
1974. The zoogeography and evolution of Tasmanian Oligochaeta. In 'Biogeography and Ecology in Tasmania.' Ed. W. WILLIAMS. (Junk: Den Hague).
- JAMIESON, B. G. M. and BRADBURY, E. A., 1972. Investigation of the Australian earthworm genus *Didymogaster* (Megascolecidae: Oligochaeta) and discrimination of populations by analysis of setal ratios. *Pedobiologia* **12**: 111-22.
- JENSZ, R. L. and SMITH, B. J., 1969. Catalogue of Baldwin Spencer earthworm types in the National Museum of Victoria, Australia. *Mem. natn. Mus. Vict.* **29**: 85-110.
- KIKKAWA, J. and PEARSE, K., 1969. Geographical distribution of land birds in Australia—a numerical analysis. *Aust. J. Zool.* **17**: 821-40.
- MICHAELSEN, W., 1900. 'Das Tierreich,' Vol. 10, Vermes, Oligochaeta. (Friedländer: Berlin).
1907. Oligochaeta In 'Die Fauna Südwest-Australiens.' Bd 1. Lief. 2, pp. 117-232. (Gustav Fischer: Jena).
1916. Results of Dr E. Mjöberg's Swedish Scientific Expeditions to Australia 1910-1913. Oligochaeten. *K. svenska VetenskAkad. Handl.* **52** (13): 3-74.
- PERRIER, E., 1872. Recherches pour servir a l'histoire des lombriciens terrestres. *Nouv. Arch. Mus. Hist. nat., Paris* **8**: 19-197.
- SPENCER, W. B., 1900. Further descriptions of Australian earthworms, part I. *Proc. R. Soc. Vict.* (n.s.) **13** (1): 29-67.
- STEPHENSON, J., 1930. 'The Oligochaeta'. (Clarendon Press: Oxford).
- SWEET, G., 1900. On the structure of the spermiducal glands and associated parts in Australian earthworms. *J. Linn. Soc., Zool.* **28** (180): 109-39.